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Ohio Energy Status Report

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INTRODUCTION

In accordance with Section 1551.04(E) of the Ohio Revised Code, the Ohio Department of Energy (ODOE) hereby submits its annual Energy Status Report.

We are pleased to report that there is no foreseeable shortage of conventional fuels in Ohio during the coming decade. The background for this conclusion will be discussed in the statistical summary sections of this report. In addition, for many of the Tables and Figures presented there will be explanatory comments and conclusions offered.

A projection of Ohio energy demand through the year 1991 gives some idea of what the state energy situation may be in a decade. However, it is not possible to view ten years into the future with certainty given the possibility of another oil embargo; economic recovery or a deepening recession; turmoil in other parts of the world which may affect the United States and our economy; decontrol and deregulation of the nation's oil and natural gas reserves; or technological innovation during these years.

However, there is one irrefutable conclusion we will make for the coming decade. It is that fuel prices will continue to escalate—perhaps not at the rate experienced during the 1970's, but a rise in fuel prices will occur. Natural gas prices to Ohio consumers will be the most rapidly increasing fuel prices throughout the 1980's.

This price rise will result in a demand-side constraint, either through retrofitting and adding insulation or changing energy consumption habits. We have seen that the conservation ethic in Ohio has had a significant effect on consumption.

We estimate that Ohioans reduced their consumption by 313 trillion Btu (nearly 8 percent) between 1979 and 1980 and an additional 4 percent from 1980 to 1981. (See Table 1) A recent audit by USDOE credits ODOE programs with a net savings of at least 66 trillion Btu, with additional "probable" savings of 54 trillion Btu.

A conservative estimate of Ohio energy prices of $3.00 per million Btu thus indicates that the Department efforts saved Ohio consumers between $200 and $330 million during 1980. These savings are attributed to the State Energy Conservation Plan (SECP). The remaining energy savings accrued from a combination of the recession which had an effect on industrial and individual energy consumption, plus cost-avoidance practices by consumers in their installation of insulation, "dialing down" thermostats, and initiation of other conservation measures.

ODOE coordinated the design and development of the State Residential Conservation Program (RCS) which has been endorsed and implemented by the State's regulated utilities, insulation contractors, and others.

Another ODOE program is the Ohio Energy Extension Service (EES) which provides matching funds for a variety of locally designed energy conservation information and assistance programs. In 1981, over $1 million was channeled into local and regional programs.

The informational and retrofit opportunities afforded to Ohio's residential consumers under the new RCS and EES programs are in addition to the continuing efforts of our State Energy Conservation Plan. It is reasonable to anticipate much greater future dollar savings on utility bills for Ohioans with the addition of these programs.

For the past four years ODOE has administered the Title III program of the National Energy Conservation Policy Act, which provides funds for audits, engineering and some retrofit funding for Ohio schools, hospitals and certain buildings operated by units of local government. In 1981, ODOE administered $12.4 million in grants and has recommended an additional $2.4 million for funding during the current year. This program has operated at minimal cost to the Ohio General Revenue Fund.

ODOE has maintained a toll-free Energy "Hot Line" for the past four years, during which time over one half million pieces of literature, energy audit forms, and information referrals have been handled. During 1981, more than 10,000 telephone contacts were accommodated through this information service.

Public transportation usage in Ohio increased 12.2 percent from 1979 to 1980. Over 240 million riders utilized public transportation in Ohio last year. ODOE was instrumental in the initiation, production and delivery of a statewide education and awareness program for public transportation in 1981. These efforts are continuing in 1982.

The industrial and commercial sector has been served through a variety of demonstration projects and institutional programs conducted under contract. Recovery of waste heat has been accomplished as a result of major boiler retrofitting, with fuel savings in the order of 5-10 percent and paybacks of less than three years. Combustion efficiency has been improved where industry was shown how to measure and control excess combustion air and to reduce fuel use in production furnaces through specific containment techniques.

Information on proven conservation methods continues to be presented to general audiences and to specialized groups through workshops and seminars. One series is reaching energy managers in six medium-sized cities. Another has addressed particular industries such as stone, clay and glass, bakeries, warehouses, and others throughout the state

Energy audit manuals have been made available to industry groups including structural clay products, iron and steel foundries, blast furnaces, and inorganic and organic chemicals. Another series of eight manuals for conducting Class A audits is available for major Ohio industries. Technical assistance was provided to selected industrial groups in utilizing their industrial wastes as a source of energy.

Solar energy opportunities in Ohio are administered by the Ohio Solar Office, now in its fourth year of operation. The office promotes the exchange of information, technology, and solar applications to assist in further reduction of dependence on conventional fuels.

Since the development of the Solar Office Data Bank, requests for information have steadily increased. In addition to responding to a large volume of mail requests, the office also renders assistance through telephone and office consultations. These requests for information range from relatively simple ones to those requiring in-depth analysis.

But even though interest in solar application has been on the increase, many Ohioans are either misinformed or uninformed about the possibilities for utilizing renewable energy. To publicize solar opportunities, the Solar Office has implemented a state-wide comprehensive solar energy educational and promotional campaign to be effective via radio/TV spots, county fairs, the Ohio State Fair, and numerous presentations at public meetings. This campaign reached approximately 5 million Ohioans.

The finite nature of petroleum and natural gas which provided the nation with over 70 percent of its energy needs in 1981 gives rise to the need for alternative energy and greater utilization of resources currently being expended. Within the economic limits and constraints, ODOE has monitored, pursued and promoted many short- and long-term projects which will extend the life of our fossil fuel base.

These projects include, but are not limited to, coal combustion, alcohol fuels from grain, waste heat recovery, cogeneration, enhanced oil recovery, oil and natural gas from our abundant shale formations, coal gasification and liquefaction, oil mining, coal/oil mixtures, chemical and electronic cleaning of coal, and identification, transport and utilization of in-state resources.

Our philosophy is that we can no longer afford avoidable waste of Ohio energy resources. We cannot waste what we have, what we use, nor can we overlook the potential of our reserves. Each component of Ohio's energy system must be addressed: better recovery techniques; better utilization technologies; more efficient machineries; and a commitment to do much more while using less energy.

The energy posture of the current Administration in Washington is important to Ohioans. There have been speculations about the future role of USDOE, however, it no longer appears that this agency will be phased out as previously suspected. However, there will be cutbacks and shutoffs of funding for many federal programs which heretofore have been channeled through the states.

Many of these programs have been restored and we anticipate that others will follow, but the implication is quite clear that the states will be called upon to take a greater responsibility in responding to consumer energy concerns and developing in-state energy resource alternatives. This is well within keeping of the federal Administration's attitude of allowing the individual states to establish priorities and goals according to their own individual needs rather than dictate uniform national guidelines which may or may not be applicable to Ohioans.

STATISTICAL SUMMARIES

The following Tables and Figures describe the Ohio energy profile, historic, current and projected. Figures for natural gas and electricity consumption are based upon monthly reports submitted to the ODOE by Ohio natural gas and electric utilities. Coal consumption figures are based on U.S. DOE data. Sectoral breakdowns of petroleum consumption, with the exception of the transportation sector, have been estimated in many instances due to the unavailability of relevant data in the desired categorical classifications.

The models used to establish these estimates have been thoroughly tested and improved upon by the ODOE Division of Information and Forecasting which has been responsible for assembling the data we present in this report.

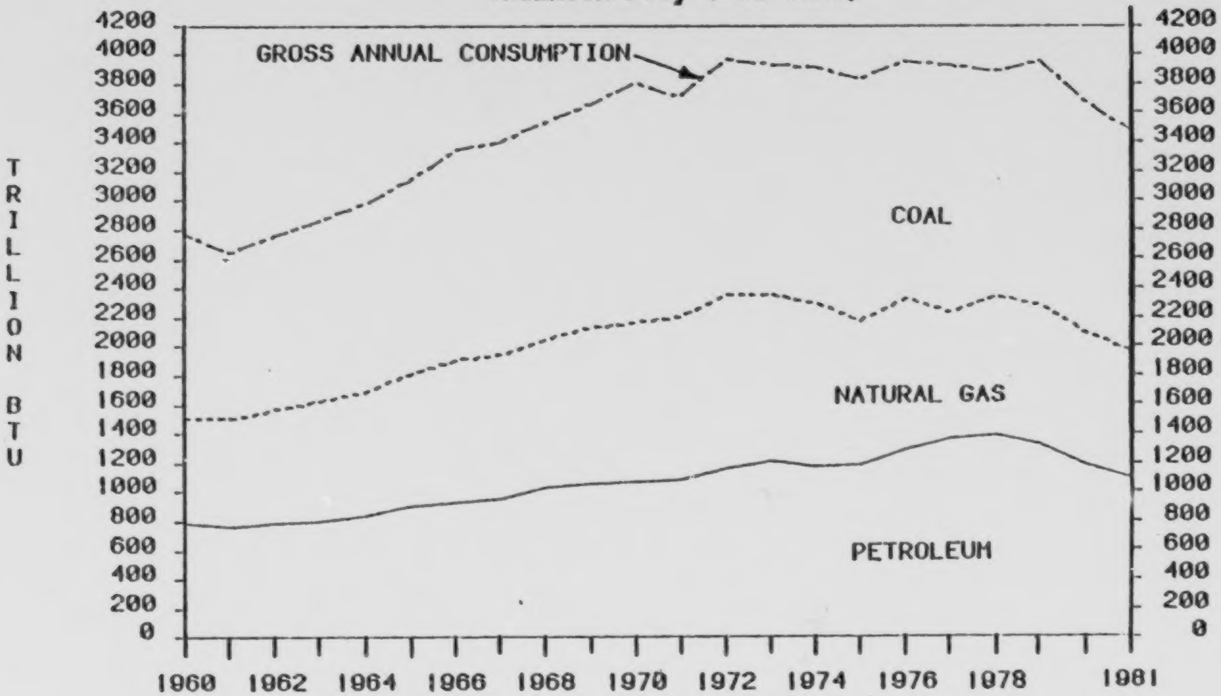
Table 1. Ohio Gross Energy Consumption by Fuel, 1971-1981.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Coal											
Million Short Tons	63.30	67.91	65.66	69.72	68.08	71.02	74.19	67.96	72.80	67.30	64.14
Trillion Btu	1,511.70	1,620.31	1,581.89	1,620.76	1,659.01	1,632.45	1,691.52	1,543.45	1,674.36	1,579.67	1,510.90
% of Total	40.7%	40.8%	40.2%	41.4%	43.2%	41.2%	43.0%	39.5%	42.2%	43.0%	42.9%
Petroleum											
Million Barrels	203.07	218.39	227.98	220.23	223.70	242.32	255.62	260.34	231.67	213.68	199.85(e)
Trillion Btu	1,081.03	1,161.55	1,213.65	1,172.39	1,190.84	1,289.94	1,360.74	1,385.87	1,306.85	1,168.87	1,098.02
% of Total	29.1%	29.3%	30.8%	29.9%	31.0%	32.6%	34.6%	34.4%	32.9%	31.8%	31.2%
Natural Gas											
Billion Cu.Ft.	1,087.13	1,147.80	1,104.16	1,086.65	956.88	1,005.93	847.50	929.59	930.10	880.20	846.23
Trillion Btu	1,121.91	1,184.53	1,139.49	1,121.42	987.49	1,038.12	874.62	959.34	959.86	908.36	873.32
% of Total	30.2%	29.9%	29.0%	28.6%	25.7%	26.2%	22.2%	24.5%	24.2%	24.7%	24.8%
Nuclear & Hydro											
Billion kWh	.01	.01	.01	.01	.01	.01	.47	2.43	3.16	2.12	4.41
Trillion Btu	.10	.10	.09	.10	.10	.10	4.57	22.65	28.48	19.10	39.74
% of Total	0	0	0	0	0	0	0.1%	0.6%	0.7%	0.5%	1.2%
Total Gross Energy Trillion Btu	3,714.7	3,967.5	3,935.1	3,914.7	3,837.5	3,960.6	3,931.4	3,911.3	3,969.5	3,676.0	3,522.0(e)

SOURCE: The Ohio Department of Energy and the Federal Energy Data System (FEDS).

Estimates (e) prepared by the Ohio Department of Energy.

Figure 1. OHIO GROSS ENERGY CONSUMPTION BY FUEL, TRILLION BTU, 1960-1981.



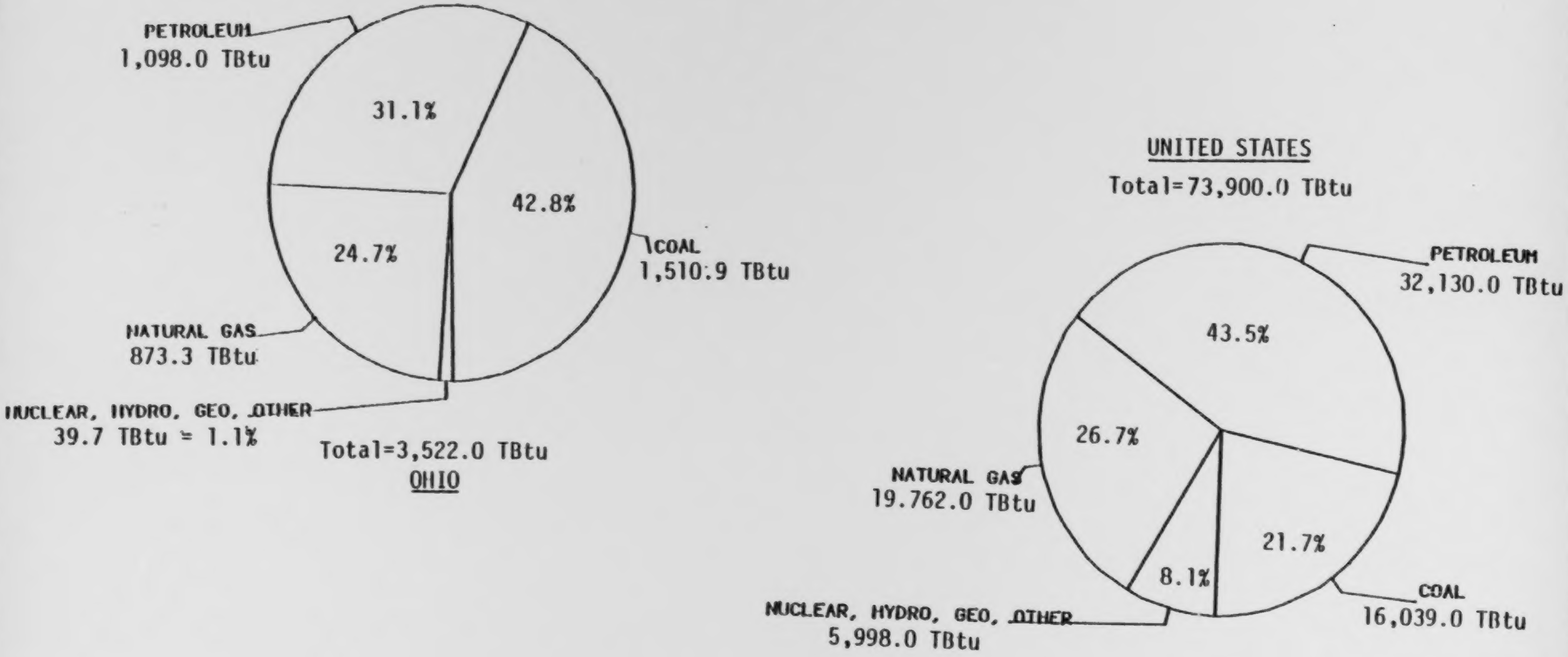
SOURCE: The Ohio Department of Energy.

Consumption of energy from Nuclear and Hydroelectric sources amounts to less than 1.5 percent of the state total and therefore is deleted from the graph.

Gross energy consumption by fuel (as shown in Table 1 and Figure 1) has dropped steadily from 1978 to 1981, and currently stands at a lower level than in 1970. Some of this drop must be credited to the economic downturn which began in 1979; however, energy use did not decrease to this extent during the recession of 1974-1975.

A nationwide trend toward lower energy consumption has become apparent, in that energy consumption per dollar of gross national product has fallen steadily from 1973 to the present. This trend is shown for Ohio in Figure 3 on page 10, which shows a downward trend for energy consumption in all Ohio economic sectors.

FIGURE 2. GROSS ENERGY CONSUMPTION BY FUEL, 1981, OHIO AND U.S.



SOURCES: U.S. Department of Energy, Monthly Energy Review, July 1982, and the Ohio Department of Energy.

Table 2. Ohio Gross Energy Consumption by Sector, 1971-1981.
(Trillions of Btu)

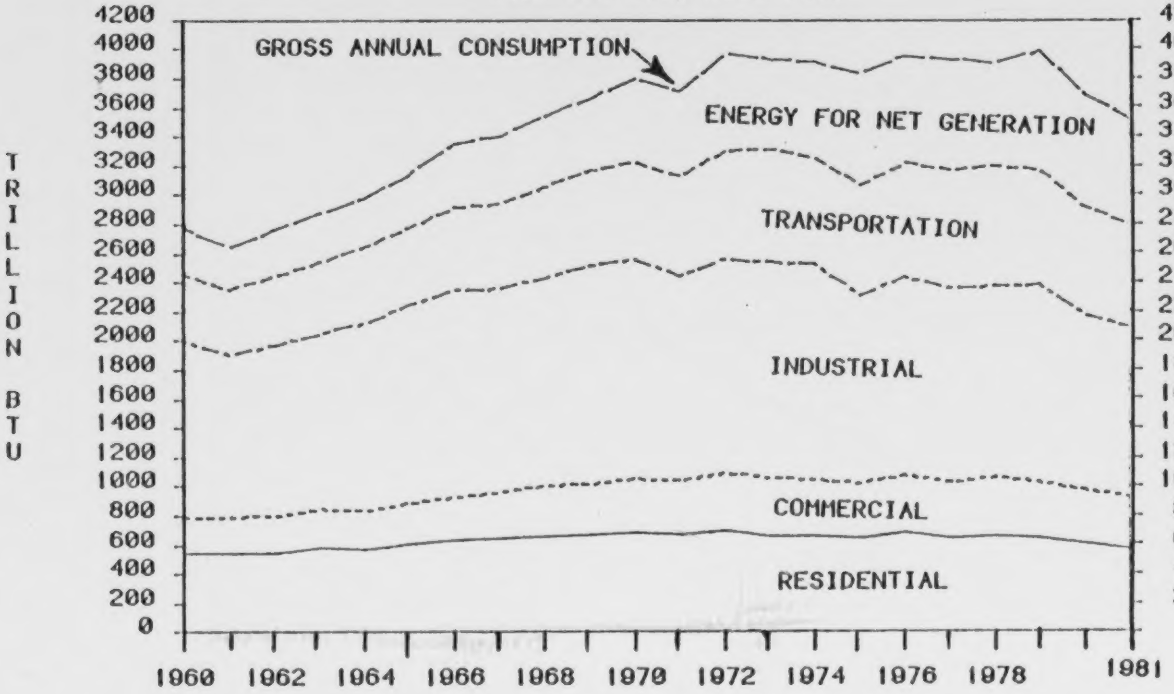
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981[b]
Residential	676.0	697.1	662.4	657.0	649.9	688.0	652.7	664.6	643.1	604.0	574.1(e)
% of Total	18.2%	17.6%	16.8%	16.8%	16.9%	17.4%	16.6%	17.0%	16.2%	16.4%	16.3%
Commercial	365.8	396.4	400.4	385.0	374.2	389.9	374.9	400.3	386.4	370.4	357.4(e)
% of Total	9.8%	10.0%	10.2%	9.8%	9.8%	9.8%	9.5%	10.2%	9.7%	10.1%	10.1%
Industrial	1,402.9	1,470.4	1,478.3	1,483.7	1,293.4	1,358.6	1,337.7	1,311.5	1,342.5	1,192.6	1,163.3(e)
% of Total	37.8%	37.1%	37.6%	37.9%	33.7%	34.3%	34.0%	33.5%	33.8%	32.4%	33.0%
Transportation	684.9	743.3	778.0	734.3	748.5	787.1	805.4	826.3	781.6	731.3	708.1(e)
% of Total	18.4%	18.7%	19.8%	18.8%	19.5%	19.9%	20.5%	21.1%	19.7%	19.9%	20.1%
Energy for Net Generation Utilities[a]	585.1	660.3	616.0	654.7	771.5	737.0	760.7	708.6	815.9	777.7	719.1
% of Total	15.8%	16.6%	15.7%	16.7%	20.1%	18.6%	19.3%	18.1%	20.6%	21.2%	20.4%
Total Consumption	3,714.7	3,967.5	3,935.1	3,914.7	3,837.5	3,960.6	3,931.4	3,911.3	3,969.5	3,676.0	3,522.0(e)

SOURCES: The Ohio Department of Energy and the Federal Energy Data System (FEDS).

[a] Energy for net generation is equal to the difference between total consumption of energy by the electric utilities sector and the Btu equivalent of the electricity generated.

[b] Estimates (e) prepared by the Ohio Department of Energy.

Figure 3. OHIO GROSS ENERGY CONSUMPTION BY SECTOR. TRILLION BTU, 1960-1981

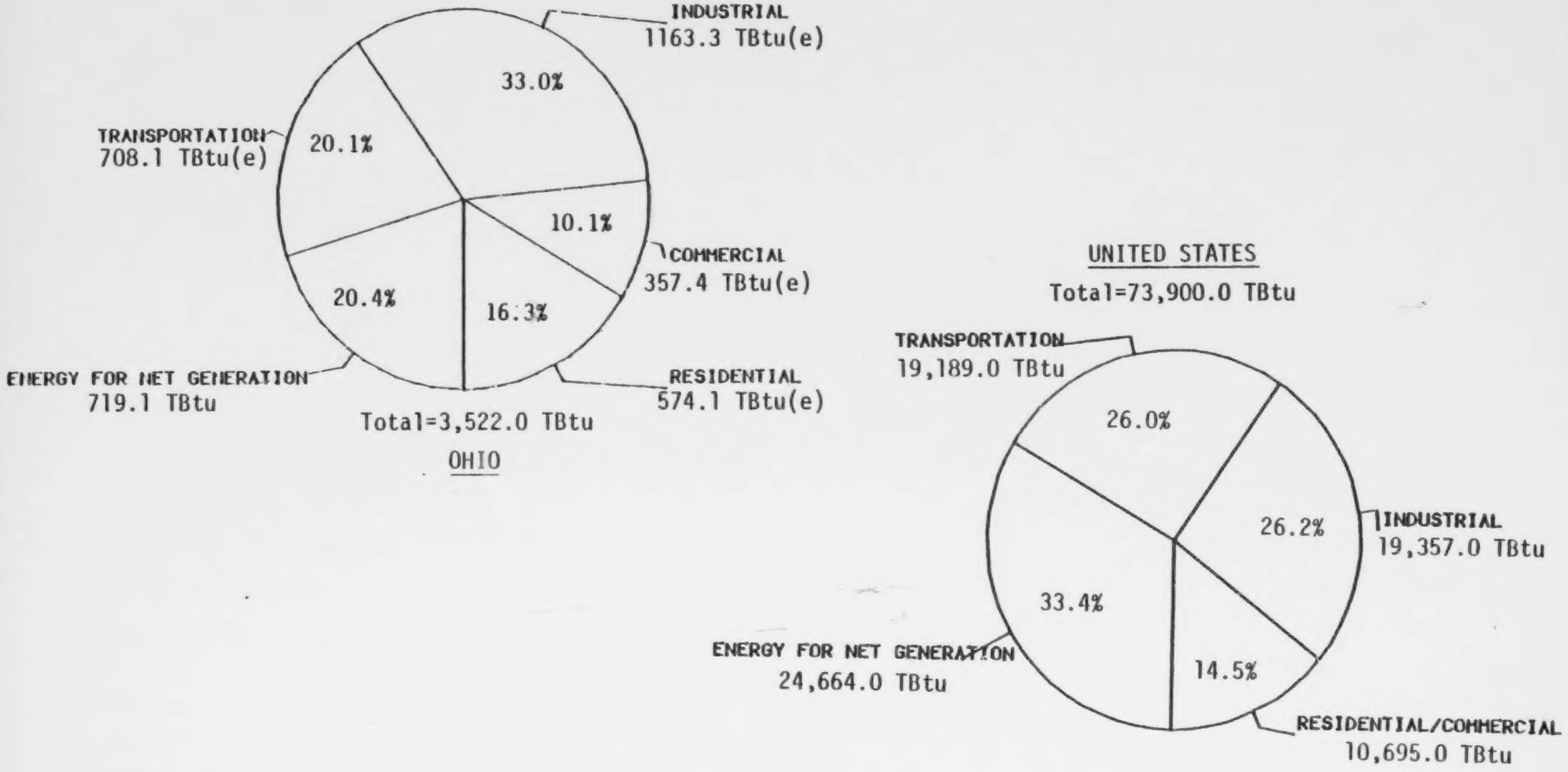


SOURCE: The Ohio Department of Energy.

Current economic conditions have contributed to overall lowered gross energy consumption, especially in the Transportation, Industrial, and Energy for Net Generation sectors; however, conservation has also played a major role. In response to continued higher energy prices and inflation, industries have learned to use process energy more efficiently and applied waste heat recovery techniques. Reductions in the transportation sector have come about through use of smaller, more efficient automobiles and vans, carpooling, and the use of public transportation. Conservation in all sectors caused the reduction in net electrical demand.

The following pages provide sector by sector fuel-use characteristics in Ohio.

FIGURE 4. GROSS ENERGY CONSUMPTION BY END-USE SECTOR, 1981, OHIO AND U.S.



SOURCES: U.S. Department of Energy, Monthly Energy Review, July 1982, and The Ohio Department of Energy.

Estimates (e) prepared by The Ohio Department of Energy.

Table 3. Ohio Gross Energy Consumption by Fuel, Residential Sector, 1974-1981

	1974		1975		1976		1977		1978		1979		1980		1981[a]	
	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu
Distillate/Kerosene (MM Bbls)	13.37	77.37	13.79	79.83	17.70	102.42	17.67	102.25	17.36	100.49	16.37	94.94	12.35	71.66	10.86	62.99
% of Total		11.8%		12.3%		14.9%		15.7%		15.1%		14.8%		11.9%		11.0%
LPG (MM Bbls)	4.98	19.98	5.16	20.71	5.31	21.29	5.00	20.05	4.87	19.54	3.37	13.52	2.53	10.15	2.53(e)	10.15(e)
% of Total		3.0%		3.2%		3.1%		3.1%		2.9%		2.1%		1.7%		1.8%
Petroleum Total	18.35	97.35	18.95	100.54	23.01	123.71	22.67	122.30	22.21	120.03	19.74	108.46	14.88	81.81	13.39(e)	73.14(e)
% of Total		14.8%		15.5%		18.0%		18.7%		18.1%		16.9%		13.5%		12.7%
Coal (Million Tons)	0.76	18.76	0.50	12.21	0.46	11.21	0.40	9.74	0.26	6.19	.20	4.76	.36	9.31	.46	11.10
% of Total		2.9%		1.9%		1.6%		1.5%		0.9%		0.7%		1.5%		1.9%
Natural Gas (Billion c.f.)	435.80	449.75	427.82	441.51	440.19	454.28	401.93	414.79	416.72	430.06	406.03	419.02	385.44	397.77	369.89	381.73
% of Total		68.5%		67.9%		66.0%		63.5%		64.7%		65.2%		65.9%		66.5%
Electric (Billion kWh)	26.72	91.17	28.02	95.60	28.95	98.78	31.03	105.87	31.75	108.33	32.50	110.89	33.75	115.15	31.68	108.09
% of Total		13.9%		14.7%		14.4%		16.2%		16.3%		17.2%		19.1%		18.8%
Total	-----	657.03	-----	649.86	-----	687.98	-----	652.7	-----	664.61	-----	643.13	-----	604.04	-----	574.06(e)

SOURCES: The Ohio Department of Energy and the Federal Energy Data System (FEDS).

[a] Estimates (e) prepared by the Ohio Department of Energy.

Conversion from physical units to TBtu based on conversion factors in the Federal Energy Data System (FEDS).

Table 4. Ohio Energy Consumption by Fuel, Commercial Sector, 1974-1981.

	1974		1975		1976		1977		1978		1979		1980		1981	
	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu
Asphalt (MM Bbls) [a]	9.26	61.46	9.03	59.90	8.13	53.94	10.15	67.32	10.85	71.99	10.55	70.00	9.09	60.33	7.62	50.55
% of Total		16.0%		16.0%		13.8%		18.0%		18.0%		18.1%		16.3%		14.1%
Distillate (MM Bbls)	4.71	27.44	4.98	29.01	6.23	36.29	6.20	36.12	6.29	36.64	6.44	37.51	4.95	28.83	4.29	24.99
% of Total		7.1%		7.8%		9.3%		9.6%		9.2%		9.7%		7.8%		7.0%
Gasoline (MM Bbls)	.83	4.34	1.13	5.95	1.07	5.61	.91	4.77	.93	4.88	1.1	5.77	2.2	11.55	1.43	7.50
% of Total		1.1%		1.6%		1.4%		1.3%		1.2%		1.5%		3.1%		2.1%
LPG (MM Blbs)	.55	2.22	.57	2.30	.59	2.37	.56	2.23	.54	2.17	.38	1.52	.28	1.12	.28(e)	1.12(e)
% of Total		0.6%		0.6%		0.6%		0.6%		0.5%		.4%		.3%		.3%
Residual (MM Bbls)	1.23	7.73	3.06	19.24	3.45	21.69	3.61	22.70	3.36	21.12	1.35	8.49	.38	2.39	.50	3.14
% of Total		2.0%		5.1%		5.6%		6.1%		5.3%		2.2%		.6%		.9%
Petroleum Total	16.58	103.19	18.77	116.40	19.47	119.90	21.43	133.14	21.97	136.8	16.44	123.29	16.90	104.22	14.12(e)	87.3(e)
% of Total		26.8%		31.1%		30.7%		35.5%		34.2%		31.9%		28.1%		24.4%
Coal (Million Tons)	.41	10.18	.27	6.63	.25	6.08	.22	5.30	.14	3.38	.10	2.38	.19	4.91	.25	6.04
% of Total		2.6%		1.8%		1.6%		1.4%		0.8%		.6%		1.3%		1.7%
Natural Gas (Billion c.f.)	192.50	198.66	169.36	174.78	179.39	185.13	149.01	153.78	172.43	177.95	170.0	175.44	167.58	172.94	162.05	167.24
% of Total		51.6%		46.7%		47.4%		41.0%		44.5%		45.4%		46.7%		46.8%
Electric (Billion kWh)	21.39	72.98	22.38	76.36	23.10	78.82	24.24	82.71	24.08	82.16	25.0	85.30	25.88	88.30	28.37	96.80
% of Total		19.0%		20.4%		20.2%		22.1%		20.5%		22.1%		23.8%		27.1%
Total	- -	385.01	- -	374.17	- -	389.93	- -	374.93	- -	400.29	- -	386.41	- -	370.37	- -	357.38(e)

SOURCE: The Ohio Department of Energy and the Federal Data System (FEDS).

Conversion from physical units to TBtu based on Conversion Factors in Federal Energy Data System (FEDS).

[a] According to U.S. Department of Energy methodology, total asphalt consumption is allocated to the commercial sector.

Estimates (e) prepared by the Ohio Department of Energy.

Table 5. Ohio Gross Energy Consumption by Fuel, Industrial Sector, 1974-1981

	1974		1975		1976		1977		1978		1979		1980		1981	
	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu
Diesel Fuel (MM Bbls)	1.68	9.79	2.04	11.88	2.80	16.31	2.29	13.34	2.54	14.80	3.58	20.85	3.35	19.51	2.44	14.21
% of Total		0.7%		0.9%		1.2%		1.0%		1.1%		1.6%		1.6%		1.2%
Distillate/Kerosene (MM Bbls)	6.24	36.35	5.89	34.31	7.48	43.57	9.39	57.70	8.51	49.57	8.27	48.12	5.45	31.32	3.24	18.83
% of Total		2.4%		2.7%		3.2%		4.1%		3.8%		3.6%		2.6%		1.6%
Gasoline (MM Bbls)	1.55	8.11	1.35	7.08	1.22	6.40	1.12	5.86	1.03	5.42	.91	4.78	1.12	5.88	.95	4.99
% of Total		0.5%		0.5%		0.5%		0.4%		0.4%		0.4%		0.5%		0.4%
LPG (MM Bbls)	1.80	7.22	1.63	6.55	1.87	7.50	2.20	9.16	3.25[a]	13.05	4.88[a]	19.57	4.50[a]	18.05	4.50(e)[a]	18.05(e)
% of Total		0.5%		0.5%		0.6%		0.7%		1.0%		1.5%		1.5%		1.6%
Residual (MM Bbls)	4.32	27.16	5 67	35.65	6.41	40.30	8.52	53.57	7.50	47.15	6.63	41.68	5.68	35.71	4.50	28.29
% of Total		1.8%		2.8%		3.0%		4.0%		3.6%		3.1%		3.0%		2.4%
Other Petro. Products[b] (MM Bbls)	21.97	124.78	20.39	115.60	20.80	129.59	23.83	135.38	24.64	139.79	24.79	140.65	24.02	136.27	24.35	145.09
% of Total		8.4%		9.0%		9.5%		10.1%		10.7%		10.5%		11.5%		12.5%
Petroleum Total	37.56	213.41	36.97	211.07	40.58	243.67	47.43	272.03	47.47	269.76	46.06	275.65	44.12	246.74	39.98(e)	230.26(e)
% of Total		14.4%		16.3%		17.9%		20.3%		20.6%		20.5%		20.7%		19.8%
Coal (Million Tons)	24.36	632.57	20.08	542.25	20.16	522.43	21.21	548.36	18.73	484.39	19.10	493.96	16.12	416.86	16.87	437.50
% of Total		42.6%		41.9%		38.5%		41.0%		36.9%		36.8%		35.0%		37.6%
Natural Gas (Billion c.f.)	427.65	441.33	344.54	355.56	373.43	305.38	285.13	294.25	328.38	338.89	339.80	350.67	314.47	324.53	302.79	312.48
% of Total		29.7%		27.5%		28.4%		22.0%		25.8%		26.1%		27.2%		26.9%
Electric (Billion kWh)	57.56	196.40	54.07	184.49	60.71	207.14	65.38	223.08	64.02	218.44	65.14	222.26	59.92	204.45	53.66	183.09
% of Total		13.2%		14.3%		15.2%		16.7%		16.7%		16.6%		17.1%		15.7%
Total	----	1,483.71	----	1,293.37	----	1,358.62	----	1,337.72	----	1,311.48		1,342.54	----	1,192.58	----	1,163.33(e)

SOURCES: The Ohio Department of Energy and the Federal Energy Data System (FEDS).

[a] Does not include ethane and butane-propane mix.

[b] Includes petroleum coking coal and petrochemical feedstocks.

Estimates (e) prepared by the Ohio Department of Energy.

Conversion from physical units to TBtu based on conversion factors in Federal Energy Data System (FEDS).

Table 6. Ohio Gross Energy Consumption by Fuel, Transportation Sector, 1974-1981.

	1974		1975		1976		1977		1978		1979		1980		1981[a]	
	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu
Distillate/Diesel (MM Bbls)	14.91	86.85	15.26	88.89	17.96	104.62	17.04	99.26	19.45	113.3	17.06	99.38	16.35	95.24	17.46	101.71
% of Total		11.8%		11.9%		13.3%		12.3%		13.7%		12.7%		13.0%		14.4%
Gasoline (MM Bbls)	114.99	603.45	116.96	613.77	121.37	636.96	125.73	659.81	127.29	667.98	122.40	642.36	112.38	589.77	107.81	565.79
% of Total		82.2%		82.0%		80.9%		81.9%		80.8%		82.2%		80.6%		79.9%
Jet Fuel (MM Bbls)	5.65	31.10	5.95	32.30	5.66	31.28	6.06	33.48	5.62	31.24	4.72	26.21	6.48	36.02	5.43	30.07
% of Total		4.2%		4.3%		4.0%		4.2%		3.8%		3.4%		4.9%		4.2%
LPG (MM Bbls)	.09	.35	.07	.28	.08	.32	.09	.34	.08	.31	.07	.28	.06	.24	.06(e)	.24(e)
% of Total		0		0		0		0		0		.04%		.03%		.03%
Residual (MM Bbls)	.33	2.07	.61	3.84	.93	5.85	.64	4.02	.65	4.09	.72	4.53	.26	1.63	.30	1.89
% of Total		0.3%		0.5%		0.7%		0.5%		0.5%		0.6%		.2%		.3%
Petroleum Total	135.97	723.82	138.85	739.08	146.0	779.03	149.56	796.91	153.09	816.92	144.97	772.76	135.53	722.90	131.06(e)	699.70(e)
% of Total		98.6%		98.7%		99.0%		99.0%		98.9%		98.9%		98.8%		98.8%
Natural Gas (Billion c.f.)	10.02	10.34	9.03	9.31	7.72	7.97	8.06	8.31	8.97	9.21	8.39	8.66	8.00	8.26	8.00	8.26
% of Total		1.4%		1.2%		1.0%		1.0%		1.1%		1.1%		1.1%		1.2%
Electric (Billion kWh)	.04	.14	.04	.14	.04	.14	.04	.14	.05	.17	.05	.17	.05	.17	.05	.17
% of Total		0		0		0		0		0		.02%		.02%		.02%
Total	-----	734.3	-----	748.53	-----	787.14	-----	805.36	-----	826.3	-----	781.59	-----	731.33	-----	708.13(e)

SOURCES: The Ohio Department of Energy and the Federal Energy Data System (FEDS).

[a] Estimates (e) prepared by the Ohio Department of Energy.

OHIO/U.S. COMPARISONS

The following Tables and Figures show how Ohio differs from the total U.S. in energy consumption patterns. (See also Figures 1 and 2)

Ohio is the fifth largest industrial state in the nation in terms of Gross State Product. Because our industrial base consists of extremely energy-intensive industries such as steel, auto, glass, plastics, non-electrical machinery, and rubber, our per-capita energy consumption is about 2 percent higher than the national average. (See Table 7)

Ohio is much more coal-intensive--more than double the national average--principally because over 96 percent of Ohio electricity demand is coal generated. And while the state is a major consumer of natural gas and petroleum products, the New England and Eastern Seaboard states, which generate electricity from oil, and the Southwestern states, which use natural gas for generation, tend to throw the total fuel-use comparisons somewhat out of perspective.

An analysis of gross energy consumption by sector reveals only small differences which could be attributed to weather patterns and commuting distances.

Home heating and electrical generation dependencies on oil in the geographic areas east of Ohio have produced the market differences in the product consumption for petroleum.

Even though Ohio is more coal-dependent than the rest of the nation, the state is still highly vulnerable to major interruptions of supply of petroleum products or natural gas. All consuming sectors would feel a major disruption should such a condition develop.

Table 7. Per Capita Energy Consumption, Ohio and U.S., 1971-1981.
(Millions of Btu)

	Ohio[a]	U.S.[b]
1971	346.0	NA
1972	369.2	NA
1973	365.5	354.6
1974	363.6	343.4
1975	356.3	331.0
1976	368.3	346.2
1977	365.0	351.9
1978	362.3	357.8
1979	367.6	357.7
1980	340.4[c]	335.1
1981	326.7[d]	322.3[d]

[a] Ohio population data 1971-1979 published in U.S. Bureau of Census, "Inter-Censal Population Estimates," February 1, 1982. Ohio energy consumption totals computed by the Ohio Department of Energy.

[b] U.S. data published in U.S. Department of Commerce, Statistical Abstract of the United States 1980. U.S. energy consumption data published in USDOE, Monthly Energy Review, June 1982.

[c] Based on state population as published in the 1980 U.S. Census.

[d] Based on population projections contained in a memo from the U.S. Bureau of Census, April 9, 1982.

Table 8. Ratio of U.S. and Ohio Energy Use to Gross National and Gross State Product, 1970-1981. (Btu per 1972 Dollar)

	U.S.			Ohio		
	GNP (Billion Constant Dollars)[a]	Energy Consumption (10^{15} Btu)	Energy Consumption per GNP dollar	GSP (Billion (Constant Dollars)[b]	Energy Consumption (10^{12} Btu)[d]	Energy Consumption per GSP dollar
1973	1.255	74.609	59,449	64.075	3935.1	61,414
1974	1.248	72.759	58,300	62.717	3914.7	62,418
1975	1.234	70.707	57,299	59.978	3837.5	63,982
1976	1.300	74.510	57,315	63.658	3960.6	62,217
1977	1.372	76.332	55,636	67.125	3931.4	58,568
1978	1.437	78.175	54,402	69.949	3911.3	55,916
1979	1.483	78.910	53,210	70.781	3969.5	56,081
1980	1.481	75.913	51,258	70.052[c]	3676.0[c]	52,475[c]
1981	1.510	73.895	48,937	69.715[c]	3522.0[c]	50,520[c]

SOURCES: U.S. Department of Commerce, Statistical Abstract of the United States 1980, Table 796. U.S. Department of Commerce, Survey of Current Business, April 1982, Table 7.1-7.2, p. 16. U.S.DOE, Monthly Energy Review, July 1982.

[a] Constant dollars (1972 = 100) based on implicit price deflators.

[b] Gross State Product figures (1973-1979) supplied by the Ohio Department of Economic and Community Development, Office of Research.

[c] Estimates calculated by the Ohio Department of Energy. Gross State Product estimates are based on average growth rate of personal income and deflated using implicit price deflators.

[d] Computed by the Ohio Department of Energy.

Table 9. Gross Energy Consumption by Fuel, by End-Use Sector, and Petroleum Consumption by Product, 1981, Ohio and U.S.

Table 9a. Gross Energy Consumption by Fuel, 1981, Ohio and U.S.

	Ohio		U.S.	
	TBtu	% of Total	TBtu	% of Total
Coal	1,510.9	42.9%	16,039.0	21.7%
Petroleum	1,098.0	31.2%	32,130.0	43.5%
Natural Gas	873.3	24.8%	19,762.0	26.7%
Nuclear, Hydro, Geothermal, Other	39.7	1.2%	5,998.0	8.1%
Total	3,522.0(e)	Total	73,900.0[a]	

Table 9b. Gross Energy Consumption by End-Use Sector, 1981, Ohio and U.S.

	Ohio		U.S.	
	TBtu	% of Total	TBtu	% of Total
Residential	574.1(e)	16.3%	10,695.0	14.5% (combined)
Commercial	357.4(e)	10.1%		
Industrial	1,163.3(e)	33.0%	19,357.0	26.2%
Transportation	708.1(e)	20.1%	19,189.0	26.0%
Energy for Net Generation	719.1	20.4%	24,664.0(e)	33.4%
Total	3,522.0(e)	Total	73,900.0[a]	

Table 9c. Petroleum Consumption by Product, 1981, Ohio and U.S.

	Ohio		U.S.[b]	
	TBtu	% of Total	TBtu	% of Total
Gasoline	578.3	55.1%	12,615.6	37.8%
Jet Fuel	29.7	2.7%	2,011.2	6.0%
Distillate, Diesel, Kerosene	229.7	19.8%	6,016.9	18.0%
Residual	33.9	2.7%	4,731.8	14.2%
Other Petroleum Products (LPG, Asphalt)	226.0	19.7%	7,993.3	23.9%
Total	1,098.0	Total	33,368.9	

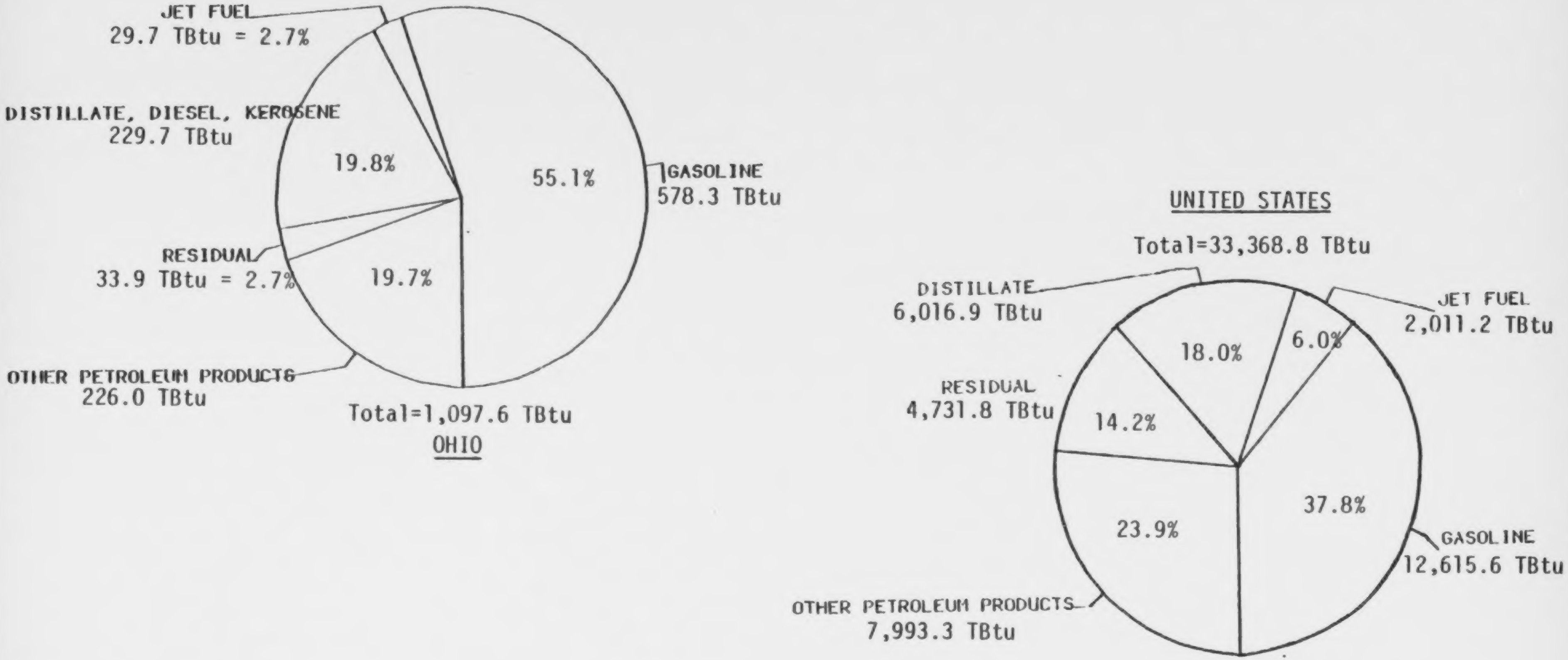
SOURCES: USDOE, Monthly Energy Review, July 1982. USDOE, Monthly Petroleum Statement, December 1981, and The Ohio Department of Energy.

[a] Totals do not add up due to independent rounding.

[b] U.S. Totals are based on disposition of petroleum fuels.

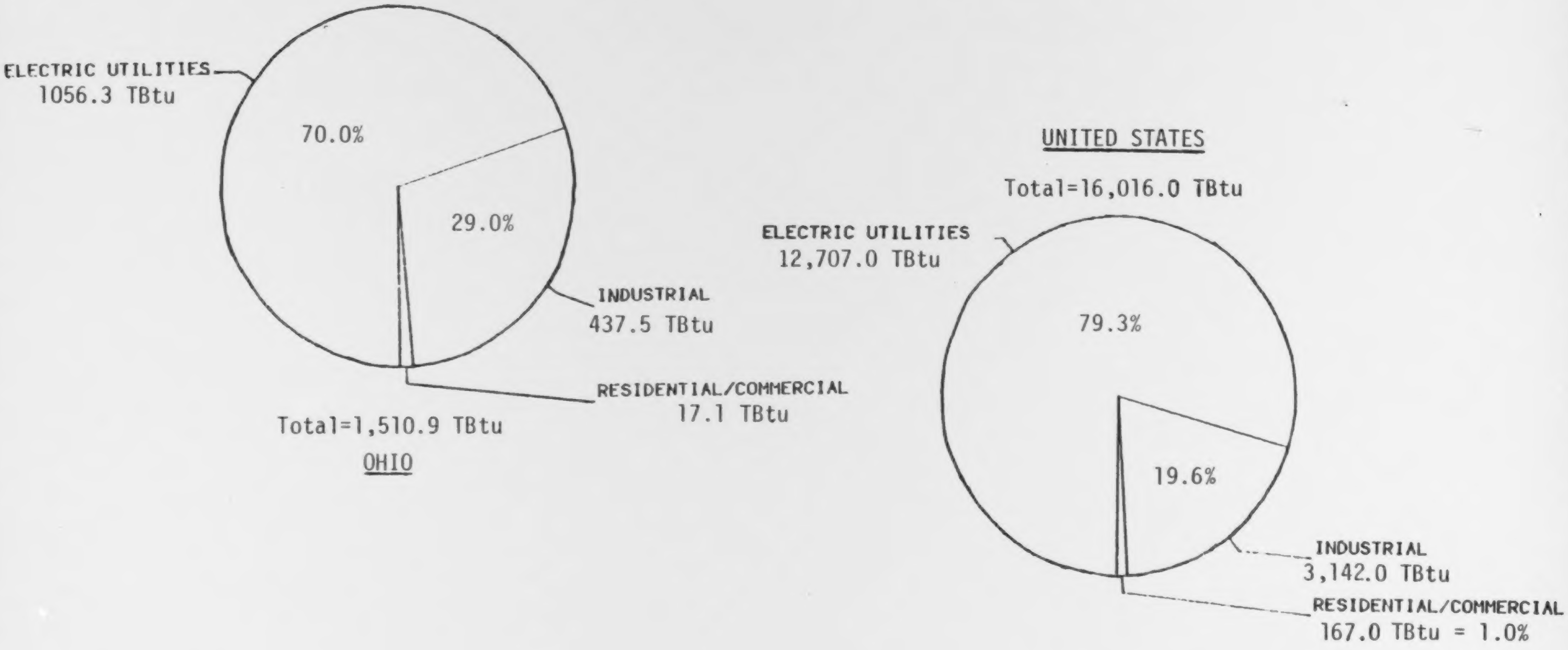
Estimates (e) prepared by the Ohio Department of Energy.

FIGURE 5. PETROLEUM CONSUMPTION BY PRODUCT, 1981, OHIO AND U.S.



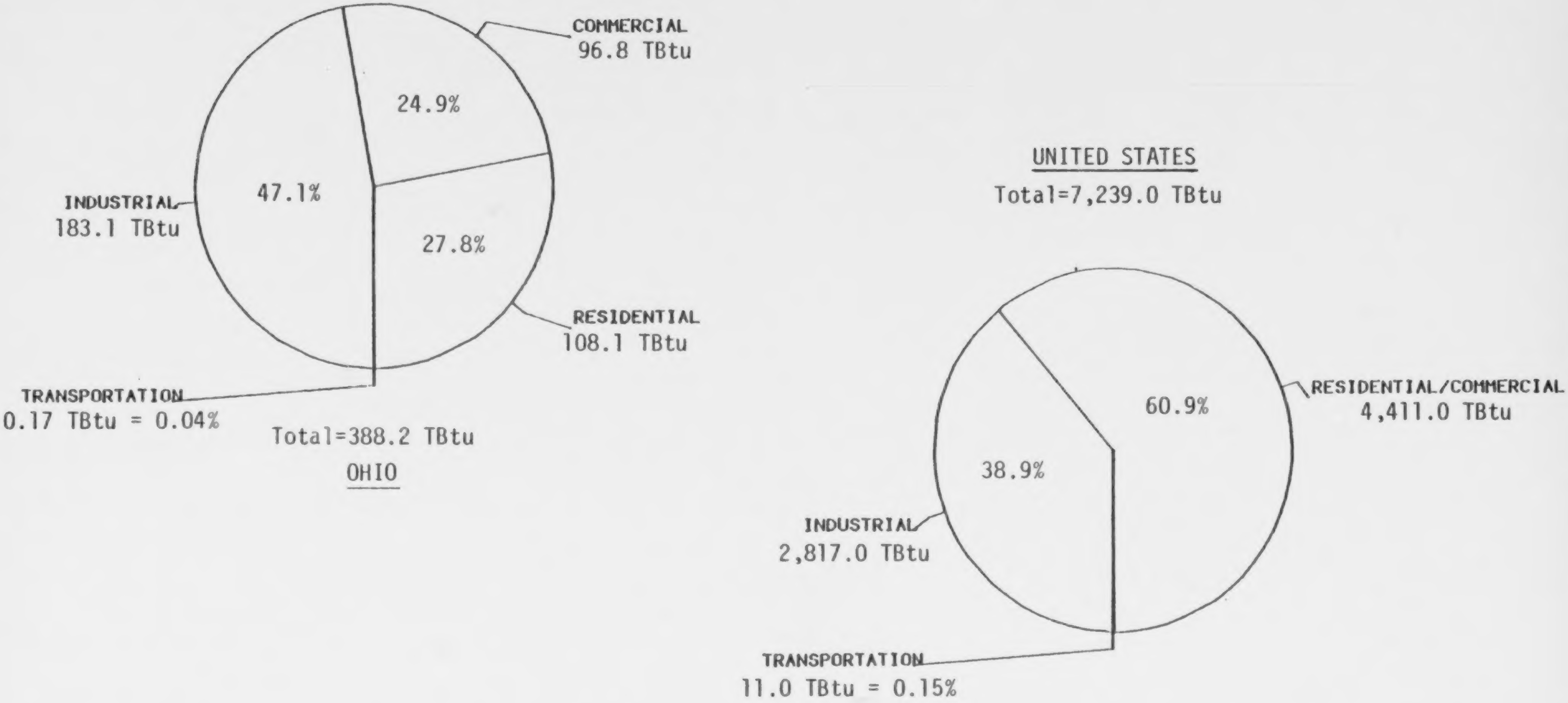
SOURCES: U. S. Department of Energy, Monthly Petroleum Statement. U.S. Department of Energy, Monthly Energy Review, June 1982, and the Ohio Department of Energy.

FIGURE 6. COAL CONSUMPTION BY SECTOR, 1981, OHIO AND U.S.



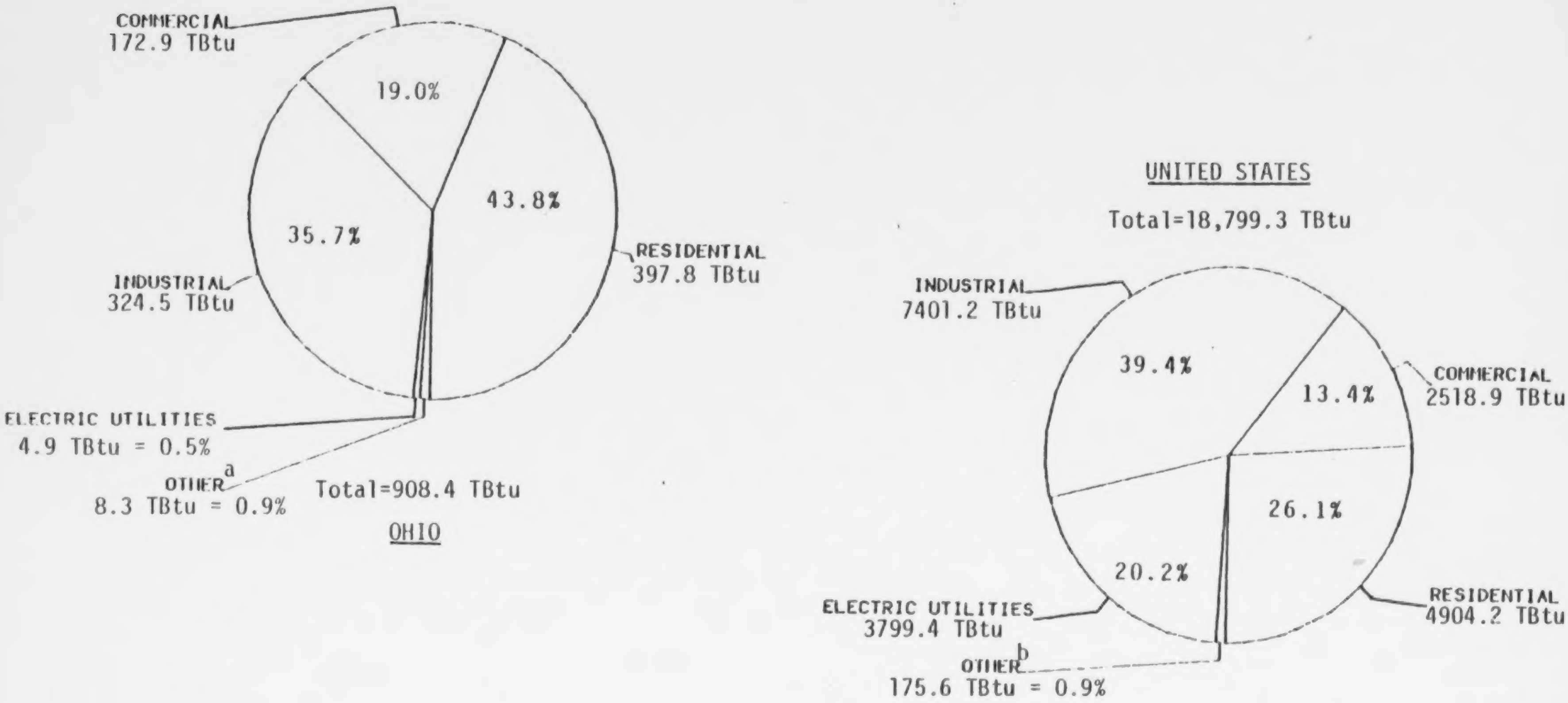
SOURCES: U.S. Department of Energy, Monthly Energy Review, June 1982, and the Ohio Department of Energy.

FIGURE 7. ELECTRICITY CONSUMPTION BY SECTOR, 1981, OHIO AND U.S.



SOURCES: U.S. Department of Energy, Monthly Energy Review, June 1982, and the Ohio Department of Energy.

FIGURE 8. NATURAL GAS CONSUMPTION BY SECTOR, 1980, OHIO AND U.S.



SOURCES: U.S. Department of Energy, Natural Gas Consumption Annual 1980, February 1982, Table 11, (formerly: Natural Gas Production and Consumption), and the Ohio Department of Energy.

[a] The "Other" sector for Ohio includes natural gas used for transportation.

[b] The "Other" sector for the U.S. consists of use by consumers not included on U.S.DOE Form EIA-176.

CONSUMER PRICES OF OHIO FUEL

A combination of the oil embargo and the ensuing price hikes by OPEC nations, inflation, and phased decontrol of natural gas have combined to impose inordinate and unexpected price increases for petroleum and natural gas in Ohio within the past several years. While gasoline and fuel oil price rises have stabilized along general economic and inflationary trends --sudden increases can occur at any time due to non-free market policy decisions of OPEC as well as the inherent instability of key OPEC producer countries--our nation's source for over thirty percent of its supply.

As the price of imported oil rises, so will the price of natural gas. As wellhead gas price decontrol continues on its current path, natural gas prices may eventually reach parity with oil prices.

Electricity prices have risen. In some regions of the country it is because oil-fired generators have suffered the OPEC price increases. In other locations it is because of decontrol of natural gas prices. As Ohio is virtually non-dependent on oil or gas for electric generation, Ohio electricity prices have not risen so steeply as elsewhere.

In Ohio the price of electricity has risen because of the increased price of coal; the inability to utilize two nuclear generating plants for which consumers are paying; antiquated coal-fired plants; Clean Air Act restrictions that require high capital investment or the expensive imports of low-sulfur coal; and the current high interest rates that either inhibit or prohibit Ohio's electric utilities from plant investment for more efficient operation, including pollution control equipment which would permit burning low-cost, high-sulfur Ohio coal.

Table 10. Natural Gas Prices in Ohio, 1970-1981.
(Dollars per MCF)

	Current Dollars[a]			Constant Dollars[b]		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial
1970	0.86	0.75	0.54	0.74	0.64	0.46
1971	0.99	0.84	0.58	0.82	0.70	0.48
1972	1.05	0.89	0.64	0.84	0.71	0.51
1973	1.11	0.97	0.67	0.83	0.73	0.50
1974	1.27	1.10	0.88	0.86	0.74	0.60
1975	1.56	1.39	1.15	0.96	0.86	0.71
1976	1.85	1.68	1.47	1.09	0.99	0.86
1977	2.30	2.13	2.01	1.27	1.17	1.11
1978	2.51	2.31	2.11	1.28	1.18	1.08
1979	2.87	2.65	2.39	1.32	1.22	1.10
1980	3.56	3.33	3.06	1.44	1.35	1.24
1981	4.01	3.78	3.53	1.62	1.53	1.43

SOURCES: The American Gas Association, Gas Facts. U.S. Department of Commerce, Statistical Abstract of the United States 1980. U.S. Department of Commerce, Survey of Current Business, April 1982.

[a] Current dollar prices represent annual average prices paid by Ohio consumers, with the exception of the 1981 current dollar figures, which represent prices for the entire East North Central census region.

[b] The constant dollar figures (1967 = 100) reflect the real price increases of natural gas, excluding the effects of the general inflation rate. They show the actual impact of natural gas price increases on consumers, given a constant rather than declining purchasing power of the dollar. Dollar values have been deflated using the Consumer Price Index for "All Items."

Table 11. Electricity Prices in Ohio, 1970-1981.
(Dollars per kWh)

	Current Dollars[1]			Constant Dollars[5]		
	Residential[2]	Commercial[3]	Industrial[4]	Residential	Commercial	Industrial
1970	0.0209	0.0341	0.0200	0.0180	0.0293	0.0172
1971	0.0219	0.0352	0.0219	0.0181	0.0291	0.0181
1972	0.0230	0.0369	0.0228	0.0184	0.0281	0.0182
1973	0.0233	0.0372	0.0234	0.0175	0.0280	0.0176
1974	0.0250	0.0383	0.0247	0.0169	0.0259	0.0167
1975	0.0345	0.0484	0.0322	0.0214	0.0300	0.0200
1976	0.0366	0.0487	0.0342	0.0215	0.0286	0.0201
1977	0.0421	0.0540	0.0415	0.0232	0.0298	0.0229
1978	0.0452	0.0588	0.0430	0.0231	0.0301	0.0220
1979	0.0491	0.0627	0.0474	0.0226	0.0288	0.0218
1980	0.0565	0.0696	0.0547	0.0229	0.0282	0.0222
1981	0.0614	0.0803	0.0612	0.0225	0.0295	0.0225

SOURCES: Federal Power Commission, Typical Electric Bills (1970-1977). U.S. Department of Energy, Typical Electric Bills (1978-1981). U.S. Department of Commerce, Statistical Abstract of the United States 1980. U.S. Department of Commerce, Survey of Current Business, April 1982.

[1] All current dollar figures are based on population weighted state average monthly bills for cities of 2,500 people or more. Prices as of January 1 of respective years.

[2] Average price per kWh of 500 kilowatt-hours of consumption.

[3] Average price per kWh of 1,500 kilowatt-hours per month consumption.

[4] Average price per kWh of 60,000 kilowatt-hours per month consumption.

[5] The constant dollar figures (1967 = 100) reflect the real price increases of electricity, excluding the effects of general inflation, and relative to consumption of all goods. They show the actual impact of electricity price increases on consumers, given a constant rather than declining purchasing power of the dollar. Dollar values have been deflated using the Consumer Price Index for "All Items."

Table 12. Gasoline Prices for Selected Cities in Ohio, 1973-1982. (Dollars per Gallon)[1]

	Leaded Regular		Unleaded Regular		Leaded Premium	
	Cincinnati	Cleveland	Cincinnati	Cleveland	Cincinnati	Cleveland
1973	.45	.45	NA	NA	.49	.48
1974	.53	.53	NA	NA	.57	.57
1975	.58	.59	NA	NA	.63	.63
1976	.59	.59	.61	.61	.64	.64
1977	.61	.61	.65	.64	.67	.66
1978	.65	.65	.69	.69	.72	.72
1979	.97	.97	1.02	1.02	1.04	1.03
1980	1.17	1.18	1.23	1.23	NA	NA
1981	1.27	1.30	1.35	1.39	NA	NA
1982	1.15	1.23	1.23	1.28	NA	NA

SOURCE: U.S. Bureau of Labor Statistics, Consumer Prices: Energy and Food.

[1] Prices as of December of each year except 1982 (May).

Table 13. Ohio[a] No. 2 Fuel Oil (Home Heating) Average Annual Prices by Sector, 1976-1982. (Current Dollars Per Gallon)

Year	Residential	Institutional/ Utility	Industrial
1976	0.39[b]	0.32[b]	0.33[b]
1977	0.45	0.37	0.38
1978	0.47	0.38	0.39
1979	0.70	0.59	0.61
1980	0.96	0.96	0.84
1981	1.16	1.03	1.08
1982	1.17[c]	1.01[c]	1.07[c]

SOURCES: U.S. DOE, *Monthly Energy Review*. U.S. DOE, *Monthly Petroleum Product Price Report*. U.S. DOE, *Heating Oil Prices to Ultimate Consumers*.

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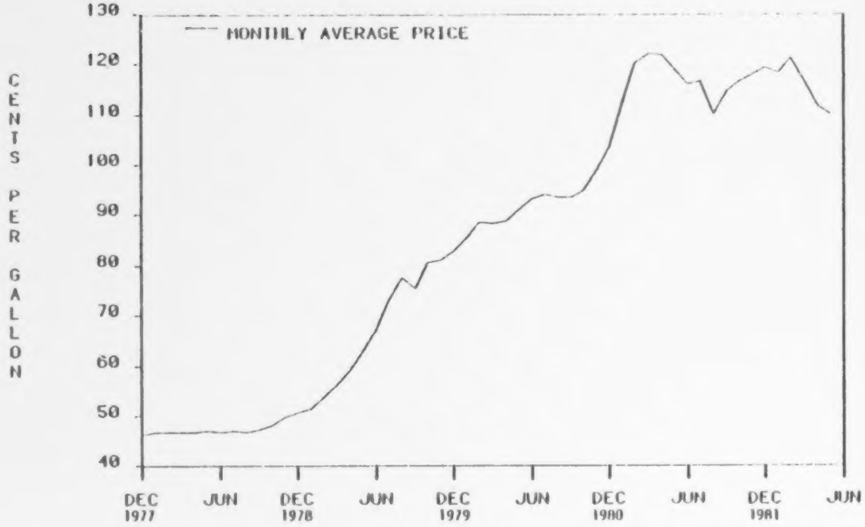
[a] Figures are representative of U.S. DOE Region 5, the East North Central geographical region.

[b] June through December only average.

[c] Based on January and February data only.

Figure 9. Ohio Average Residential Sector Prices of No. 2 Fuel Oil, December 1977-May 1982. (Current Cents Per Gallon)



SOURCE: U.S. Department of Energy, Energy Information Administration, "Prices and Margins of No. 2 Distillate Fuel Oil," EIA-0013, and The Ohio Department of Energy Monthly Heating Oil Price Monitoring Survey.

OHIO ENERGY PRODUCTION AND RESERVES

Ohio is a heavy energy consuming state, principally because of a strong energy intensive industrial base, our aged housing stock, and the wide temperature extremes generally experienced here. Although Ohio does not produce as much energy as the Southwestern and Gulf states, we do have significant production capabilities and reserves to assist in the reduction of out-of-state energy imports and the consequent export of Ohio dollars.

Coal is Ohio's largest energy resource. We have an estimated 18.941 billion tons of economically recoverable coal in Ohio, although its high-sulfur content presents environmental utilization problems. Partly for that reason, use of Ohio coal in the state has declined steadily since 1977. (See Table 19) Ohio is the largest coal user in the United States, consuming about 64.1 million tons in 1981. About 44 percent of this in-state consumption (28.4 million tons), is supplied by Ohio-produced coal.

Exports of Ohio coal to other states and foreign countries have dropped during the past decade, from 19.6 million tons in 1970 to 9.1 million tons in 1981, a drop of almost 54 percent over that period. (This includes foreign exports of 591,000 tons, predominantly to Canada).

Coal continues to be the major fuel for the generation of electricity in Ohio, representing about 96 percent of the fuel for net generation. By the mid-1980's Ohio may have three nuclear plants in operation, which will diminish total utility use of coal, however the majority of the coal displaced will be out-of-state coal.

Ohio is currently a net importer of electricity, with the major purchasers of out-of-state generation being Toledo Edison, Cleveland Electric Illuminating Company and Ohio Edison. However, as the Davis-Besse nuclear generating plant is fully operational and the other two nuclear plants (Zimmer and Perry) come on line, net imports will be reduced.

Ohio also has extensive reserves of natural gas and oil, and these reserves should continue to climb as deregulation and decontrol progress. As the price of crude oil climbs through deregulation, many oil fields once thought to be economically depleted are now coming back into play. However, it is unlikely that Ohio will approach self-sufficiency in petroleum because our production is only a small fraction of the state's requirements, and the grade of oil produced here is more adaptable to finishing into lubricants than into gasoline. However, the additional crude oil production we anticipate will add millions of dollars to the state's economy.

The past few years have seen a sharp increase in natural gas production in Ohio. In 1981, producers drilled four times as many wells as in 1975. Last year, Ohio produced about 13 percent of state consumption requirements. As transportation facilities are upgraded and expanded, significant additional volumes of Ohio-produced gas are expected to flow.

Table 14. Electric Generating Capacity Serving Ohio, 1981, 1986, 1991[a].
(Megawatts)

	1981	1986	1991
Coal	29,151.8	30,714.4	31,903.9
Oil and Gas	2,347.4	2,102.4	2,017.4
Nuclear	1,305.0	3,263.1	4,000.1
Hydro, Pumped Storage	365.0	398.7	398.7
Total	33,169.2	36,478.6	38,320.1

SOURCES: Ohio Electric Utilities' Ten-Year Forecasts, Forms FE-6 and FE-7(c).

[a] Ohio future share of capacities of plants serving in and out-of-state consumers is estimated as the proportion of system net energy for load that is in-state in 1986 and 1991. Figures include upratings and retirements.

Table 15. Ohio Electric Utility Energy Account, 1978-1981[a].

	1978			1979			1980			1981		
	Physical Units	TBtu[c]	Percent of Total[b]	Physical Units	TBtu[c]	Percent of Total[b]	Physical Units	TBtu[c]	Percent of Total[b]	Physical Units	TBtu[c]	Percent of Total[b]
Deliveries												
Coal (tons)	46,533,855	990.2	95.8	52,893,900	1130.9	97.4	49,029,300	1044.3	98.3	44,461,200	947.0	95.8
Oil (barrels)	6,538,400	40.7	3.9	4,464,000	27.9	2.4	2,329,500	14.6	1.4	6,449,000	40.3	4.1
Natural Gas (MCF)	2,405,900	2.5	0.2	2,051,100	2.1	0.2	3,235,400	3.3	0.3	1,299,400	1.3	0.1
Consumption												
Coal (tons)	48,580,077	1033.8	95.8	51,493,046	1100.9	97.2	47,917,401	1020.6	98.3	47,589,702	1013.7	99.2
Oil (barrels)	6,970,823	43.4	4.0	4,470,256	27.9	2.5	2,170,160	13.6	1.3	1,036,044	6.5	0.6
Natural Gas (MCF)	2,285,642	2.4	0.2	4,169,184	4.3	0.4	3,750,299	3.9	0.4	1,360,497	1.4	0.1
Generation (MWH)												
Coal	102,192,489	348.8	95.4	110,952,383	378.6	95.8	106,209,896	362.4	97.3	105,747,220	360.8	95.8
Oil	2,754,001	9.4	2.6	1,645,722	5.6	1.4	701,757	2.4	0.6	167,614	0.6	0.2
Natural Gas	87,729	0.3	0.1	102,252	0.3	0.1	168,491	0.6	0.2	69,361	0.2	0.05
Nuclear	2,056,880	7.0	1.9	3,163,138	10.8	2.7	2,119,116	7.2	1.9	4,406,819	15.0	4.0

SOURCE: Federal Power Commission forms 4 and 423, and the Ohio Department of Energy.

[a] Figures are for eight major electric utilities generating electricity in Ohio. Buckeye Power, municipal and industrial utilities are excluded.

[b] Percent totals may not add to 100 due to independent rounding.

[c] Conversion from physical units to TBtu based on "Conversion Factors" published in U.S.DOE, Monthly Energy Review, June 1982.

Table 16. Ohio Utility Disposition of Electricity in 1981.
(Megawatt-hours)

	Net Energy for Load	Net Ohio Generation	Energy Bought (Sold) From (To) Out-of-State or Other Utilities
Buckeye Power	3,598,861	7,523,149	(3,924,288)
Cincinnati Gas and Electric	13,663,858	13,755,267	(91,409)
Cleveland Electric Illuminating	18,938,963	15,061,031	3,877,932
Columbus and Southern Electric	9,773,150	11,342,229	(1,569,079)
Dayton Power and Light	10,986,544	10,055,782	930,762
Monongahela Power	597,779	---	597,779
Ohio Edison	20,470,559	16,130,740	4,339,819
Ohio Power	28,757,604	26,650,592	2,107,012
Ohio Valley Electric Corporation	7,018,132	6,903,882	114,250
Toledo Edison	7,594,608	7,437,533	157,075
Total	121,400,058	114,860,205	6.539.853

SOURCES: Forms FE-1(A) and (D) of the Ohio Electric Utility 1982 Ten Year Forecasts.

Table 17. Ohio Proven Reserves by Fuel, 1970-1981.

Year	Crude Oil (1000 Bbls.)	Natural Gas (MMcf)	Coal (Million Short Tons)
1970	127,912	557,455	20,787
1971	129,144	615,477	17,798
1972	127,385	715,151	20,680
1973	124,911	808,641	NA
1974	123,871	960,662	21,077
1975	121,263	969,020	NA
1976	125,268	1,025,950	19,230
1977	129,148	1,093,150	19,157[a]
1978	131,194	1,711,511	19,090[a]
1979	137,718	1,313,333	19,035
1980	NA	1,436,629	18,978[a]
1981	NA	1,689,745	18,941[a]

SOURCES: Ohio Department of Natural Resources, Division of Oil and Gas, Summary of Ohio Oil and Gas Developments in 1981. U.S. Department of Interior, Bureau of Mines, Minerals Yearbook. (Coal data, 1970-1974.) U.S.DOE Energy Information Administration, Demonstrated Reserve Base of Coal in the U.S., (1976 - present).

[a] ODOE estimates (based on U.S.DOE Energy Information Administration (EIA) methodology and Ohio coal production figures).

NA: Not available.

Table 18. Ohio Gross Energy Production by Fuel, 1971-1980

Year	Crude Oil (Thousand Bbls.)	Natural Gas (MMcf)	Coal (Thousand Short Tons)
1970	9,864	73,759	55,137
1971	9,670	82,678	49,017
1972	9,358	90,487	50,572
1973	8,796	94,121	45,666
1974	9,088	94,376	45,352
1975	9,578	85,810	46,673
1976	9,994	89,770	46,804
1977	10,359	99,656	46,940
1978	11,154	115,239	38,840
1979	11,953	124,665	43,528
1980	12,928	138,856	40,951
1981	13,551	141,134[a]	36,833[b]

SOURCES: Ohio Department of Natural Resources, Summary of Ohio Oil and Gas Developments in 1981, and Division of Mines, Ohio Department of Industrial Relations.

[a] Natural gas production in 1981 includes an estimated 2,055 MMcf accounting for gas utilized in the field.

[b] Preliminary estimate of Ohio Department of Industrial Relations.

Table 19. Ohio Coal Use by Source, 1970-1981.
(Thousand Short Tons)

Year	Western Coal	Eastern Coal[a]	Total Imports	Ohio Coal	Ohio Exports	Total Use[b]
1970	-0-	31,822	31,822	35,553	19,584	67,375
1971	-0-	29,513	29,513	33,603	15,414	63,116
1972	-0-	32,665	32,665	35,130	15,422	67,795
1973	-0-	32,348	32,348	33,409	12,257	65,557
1974	1,172	35,426	36,598	33,044	12,308	69,642
1975	1,433	33,118	34,551	33,468	13,205	68,019
1976	3,372	32,191	35,563	35,401	11,403	70,904
1977	4,841	33,051	37,892	36,240	10,700	74,132
1978	4,700	32,504	37,204	30,707	8,133	67,912
1979	3,835	36,908	40,745	32,059	11,619	72,804
1980	2,484	35,357	37,841	29,360	9,923	67,201
1981	2,811	32,925	35,736	28,400	9,139	64,136

SOURCES: U.S.DOE Energy Information Administration, Coal Distribution (formerly Bituminous Coal and Lignite Distribution), DOE/EIA-0125 (81), Tables 8 and 9.

[a] Eastern Region includes Maryland, Pennsylvania, West Virginia, Virginia, Kentucky, North Carolina, Tennessee, Indiana, Alabama, Georgia, Arkansas and Oklahoma. Western region includes Idaho, Utah, Wyoming, and North and South Dakota.

[b] Totals may not equal the sum of components due to independent rounding.

Table 20. Surface and Underground Production of Ohio Coal, 1973-1981.
(Thousand Tons)

	1973	1974	1975	1976	1977	1978	1979	1980	1981[a]
Underground Production	16,209.4	14,415.5	15,469.3	16,707.6	14,004.2	11,389.2	14,546	14,573	10,420
Surface Production	29,457.1	30,936.1	31,203.6	30,096.3	32,936.0	28,705.0	28,982	26,378	26,413
Total Production	45,666.5	45,351.6	46,672.8	46,803.9	46,940.1	40,094.2	43,528	40,951	36,833

SOURCE: Ohio Bureau of Industrial Relations, Division of Mines.

[a] Preliminary data from Ohio Bureau of Industrial Relations, Division of Mines.

Table 21. Well Completions in Ohio, 1970-1981[a].

	Gas Wells		Oil Wells		Combination Wells		Dry Holes		
Year	No.	Percent	No.	Percent	No.	Percent	No.	Percent	Total Wells
1970	517	38.15	325	23.99	323	23.83	190	14.02	1,355
1971	542	43.78	244	19.70	279	22.53	173	13.97	1,238
1972	588	45.47	178	13.77	359	27.76	168	12.99	1,293
1973	759	50.53	145	9.65	432	28.76	166	11.05	1,502
1974	768	43.49	247	13.99	584	33.07	167	9.46	1,766
1975	417	34.18	208	17.05	480	39.34	115	9.43	1,220
1976	816	42.14	213	11.00	743	38.37	164	8.47	1,936
1977	844	32.16	372	14.18	1,237	47.14	171	6.52	2,624
1978	844	32.39	273	10.47	1,273	48.85	216	8.29	2,606
1979	1,097	31.86	251	7.29	1,927	55.97	168	4.88	3,443
1980	818	24.37	276	8.22	2,154	64.18	108	3.22	3,356
1981	1,256	23.15	394	7.26	3,419	63.02	356	6.56	5,425

SOURCES: Ohio Department of Natural Resources, Division of Oil and Gas, Summary of Ohio Oil and Gas Developments in 1981.

[a] Does not include wells reopened, gas storage wells, secondary recovery or service wells.

Table 22. Sources of Gas Supply for Ohio Natural Gas Utilities, 1980-1981.
(Annual Purchases in MMcf)

	Interstate		Ohio Production		Green Springs[1]		Other and Storage		Total	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
Cincinnati Gas and Electric	81,887	83,252	1,407	642	6,195	6,057	12	92	89,501	90,043
Columbia Gas of Ohio	318,418	303,852	5,164	1,678	23,906	23,238	359	-604	347,847	328,164
Dayton Power and Light	61,049	56,555	0	0	611	1,965	0	1	61,660	58,521
East Ohio Gas	291,394	274,031	52,437	49,428	0	0	61,687	60,702	405,518	384,194
National Gas	8,888	9,026	5,930	5,631	0	0	707	1,019	15,525	15,676
Ohio Gas	6,192	6,165	771	824	0	0	263	384	7,226	7,373
River Gas	2,890	3,075	1,684	1,460	0	0	0	0	4,574	4,534
West Ohio Gas	13,300	12,389	0	0	889	926	0	0	14,189	13,315
Total	784,018	748,345	67,393	59,663	31,601	32,186	63,028	61,594	946,040	901,821
% of Total	82.8%	83.0%	7.1%	6.6%	3.3%	3.6%	6.7%	6.8%	100.0%	100.0%
% Change from 1980	-4.6%		-11.5%				+1.8%		-4.7%	

SOURCES: Monthly reports of eight major Ohio gas utilities to the Ohio Department of Energy.

[1] A plant producing synthetic natural gas (SNG) from naphthaslocated in Green Springs, Ohio.

Totals may not add due to independent rounding.

Table 23. Self-Help Gas Transmission (Million Cubic Feet) by Columbia Gas and East Ohio Gas, 1973-1981.

	1973-4	1974-5	1975-6	1976-7	1977-8	1978-9	1979-80	1980-1
Columbia[a]	81.88	649.24	795.89	5,271.34	9,327.38	9,604.21	8,167.30	9,323.90
	1974	1975	1976	1977	1978	1979	1980	
East Ohio Gas	700.95	3,270.59	12,176.49	19,839.17	29,285.89	29,579.89	32,204.37	
East Ohio Gas Volumes[b]	350.48	1,364.33	4,784.82	7,441.43	10,789.08	8,481.46	7,642.19	
Totals	350.48	1,906.26	7,391.67	12,397.74	18,496.81	21,098.43	24,562.18	

	Calendar Year 1981
Columbia	9,500.80
East Ohio Gas	34,939.54
East Ohio Gas Volumes	8,805.70
Transfers to Columbia[c]	7,296.98

SOURCE: Public Utilities Commission of Ohio.

[a] May include some volume listed under East Ohio Gas, due to East Ohio Gas transfer of gas to Columbia. Prior to 1981, Columbia figures are for contract years.

[b] East Ohio Gas volumes represent amount of self-help gas purchased by East Ohio Gas.

[c] Includes both self-help and gas for Columbia's use.

PROJECTED SECTORAL ENERGY CONSUMPTION IN OHIO, 1991.

The following table presents the Ohio Department of Energy's projections for the State's sectoral energy utilization levels in the year 1991 as well as a characterization of the sectoral time paths between 1981 and 1991. We also discuss the methodology and assumptions employed in developing these forecasts, and present a summary of the conclusions.

A) Methodology and Assumptions

The forecasts, as presented in Table 24, are based upon analyses of time variant linear trends in the sectoral energy consumption of the State between 1960 and 1981. The methodology for this type of analysis has been developed in-house by the Ohio Department of Energy to deal specifically with the problems involved in the forecasting and assessment of economic data series.

It can be concluded on the basis of our investigations that, in the absence of significant events affecting the general economy of the nation or of the State, established trends in energy data series tend to persist over considerable periods of time. We have experienced a number of these "significant" economic events in one recent period. These have included for example the commencement and termination of major military engagement overseas; the breakdown of the international monetary system and the subsequent severe devaluation in the U.S. dollar; the oil embargo and the emergence of a successful oil cartel; and political/military upheavals in the Middle East. Such extraordinary events tend to cause permanent changes in the magnitude and/or the direction of previously established trends through their potentially prolonged and severe impact on the structure and dynamics of prices, incomes, expectations, investments, or employment. In addition to the severe alterations in the political-economic environment, temporary fluctuations in economic activity such as the recessions of 1971, 1975, and 1980-82, whether induced by a preceding significant economic event or not, result in temporary deviations from previously established sectoral trends, as well.

It should be clear that no meaningful forecasts can be made without including consideration of the political-economic conditions which might prevail over the forecasting horizon. But it should be equally clear that these types of events cannot be explicitly predicted with any degree of reliability. Thus we must devise a proxy to satisfy the requirement to include these external conditions. One major influence that each significant event tends to have is on the State's unemployment rate. For that reason we have based the forecast presented in Table 24 upon the following scenario of average unemployment rate in the civilian labor force:

Presumed Average Rate of Unemployment of the Civilian Labor Force in Ohio -

Year	Rate
1982-83	9 - 13%
1984-85	7 - 9%
1986-91	5 - 7%

Our presumptions concerning the level of unemployment are in turn based upon a scenario that the current recession will have bottomed-out for Ohio by 1984 and a sustained recovery will ensue from 1986 on. Such a scenario of a belated recovery is based upon our belief that the structural changes required in Ohio's aging industrial base to make it competitive again nationally and internationally will probably require the kind of time frame we have stipulated above. We have presumed that no major international incident will occur during the forecasting horizon. However, we have included the 95 percent confidence intervals of the forecast which should practically cover all cases except a very major incident that could disrupt energy consumption patterns in Ohio and the U.S. It should be clear that if significant deviations from the scenario outlined above are realized during the forecasting horizon, the scenario, as well as the forecasts, would have to be adjusted and updated to take such alterations into account.

B) Conclusion

Most likely estimates of sectoral energy consumption, given our assumptions, indicate that energy consumption in all sectors of Ohio for 1991 will fall somewhere between their respective levels in 1979 and 1980. We also predict that energy consumption in all sectors will continue to decline through 1983, level out or turn upward between 1984 and 1985, and increase along sustainable trend lines between 1986 and 1991.

If actual trends follow or fall below our estimates we are confident there will be sufficient energy supplies to sustain the needs of Ohio sectoral end users in 1991.

Table 24. Projected Sectoral Energy Consumption in Ohio, 1991.
(Trillion Btu)

Sectors	Actual 1981	Estimated 1982	Change in Sectoral Consumption (TBtu/yr)			1991		
			(1) 1983	(2) '84-'85	(3) '86-'91	Lower 95% Confidence Limit	Forecast	Upper 95% Confidence Limit
Residential	574.1	566.0	-20	0	+10	570.0	606.0	642.0
Commercial	357.4	346.0	-10	- 5	+ 8	350.0	374.0	398.0
Industrial	1,163.3	1,100.0	-50	+50	+20	1,150.0	1,270.0	1,390.0
Transportation	708.1	670.0	-30	-20	+20	680.0	720.0	760.0
Energy for Net Generation	719.1	680.0	-30	+30	+20	780.0	830.0	880.0
Total	3,522.0	3,362.0	-140	+55	+78	3,530.0	3,800.0	4,070.0

GLOSSARY OF SELECTED TERMS

ASPHALT[a] - Black or dark brown solids of semi-solid materials which must be created to liquefy and are obtained as residues from the refining of certain types of crude oil, and which also occur in the solid or semi-solid form in nature.

BTU (BRITISH THERMAL UNIT)[b] - The standard unit for measuring quantity of heat energy, such as the heat content of fuel. It is the amount of heat energy necessary to raise the temperature of one pound of water one degree Fahrenheit. Based on its Btu content, any kind and quantity of fuel burned may be expressed as an equivalent quantity of some other kind of fuel. TBtu = 1.0×10^{12} Btu.

CHAR[a] - A porous, solid residue resulting from the incomplete combustion of organic material. If produced from coal, it is called coke; if produced from wood or bone, it is called charcoal. It is more nearly pure carbon than the coal, wood, or bone from which it is produced.

CLASS A AUDIT[c,a] - An on-site visit at a building by an energy specialist consisting of an evaluation of the building's energy consumption and energy systems. The evaluation includes an analysis of the energy and cost savings likely to result from the purchase and installation of one or more modifications. The audit will also include general recommendations and will provide a workbook, manual, or other instructional material enabling an owner, operator, or occupant of a building to calculate the energy and cost savings resulting from the purchase and installation of one or more modifications.

COAL GASIFICATION[d] - The conversion of coal, coke, or char to gaseous products by reaction with air, hydrogen, oxygen, steam, carbon dioxide, or a mixture of these. Products consist of carbon dioxide, carbon monoxide, hydrogen, methane, and other chamicals, usually of low to intermediate-Btu quality for industrial uses.

COAL LIQUEFACTION[d] - The conversion of most types of coal, anthracite excepted, by direct or indirect technologies (usually by hydrogenation, the addition of hydrogen) primarily to produce synthetic low-sulfur, low-ash liquid or solid fuels to replace some of the fuel coal used by electric utilities.

COGENERATION[d] - The simultaneous generation of electric energy and useful low-grade heat from the same source. Two main approaches are possible: moving electrical generation to the user's facility, and moving the waste heat to the user.

DISTILLATE FUEL[d] - A broad term for any one of the wide variety of fuels obtained from fractions boiling above gasoline in the distillation of petroleum. The most important distillate fuels are kerosene, furnace oils, and diesel fuels. (See also FUEL OIL.)

DRY HOLE WELL[a] - A drilled well which does not yield gas and/or oil in quantities or condition to support commercial production.

ENERGY FOR NET GENERATION[a] - Calculated as the difference between a) total consumption of energy by the electric utilities sector (fuels used for generation) and b) the Btu equivalent of the electricity generated (sales of electricity to all sectors).

FUEL OIL[d] - Any of the petroleum products which are less volatile than gasoline and are burned in furnaces, boilers, or other types of heaters. The two primary classes of fuel oils are distillate and residual. Distillate fuel oils are composed entirely of material which has been vaporized in a refinery distillation tower. Consequently, they are clean, free of sediment, relatively low in viscosity, and free of inorganic ash. Residual fuel oils contain fractions which cannot be vaporized by heating. These fractions are black and viscous and include any inorganic ash components which are in the crude. In some cases, whole crude is used as residual fuel.

JET FUEL[a] - Any of several compounds designated commercial jet fuels or military jet fuels including kerosene types and combinations with naphtha. They are derived mostly from the range of middle distillates.

KEROSENE[a] - A mixture of hydrocarbons obtained by the fractional distillation of petroleum and used as a fuel for jet engines and gas turbines. It consists of slightly heavier hydrocarbons than are found in gasoline and naphtha.

LIQUEFIED PETROLEUM GAS (LPG)[a,d] - Commonly known as "bottled gas." A gas containing certain specific hydrocarbons which are gaseous under normal atmospheric conditions, but can be liquefied under moderate pressure at normal temperatures. Propane and butane are the principal examples. Often employed as fuel (particularly clean-burning), for tractors, trucks, and buses, and mainly as a domestic fuel in remote areas.

OPEC[a] - The Organization of Petroleum Exporting Countries. An organization of countries in the Middle East, North Africa, and South America which aims at developing common oil-marketing policies.

PETROLEUM COKE[d] - A petroleum by-product resulting from the conversion of heavy residual bottoms of crude oil to lower-boiling petroleum products. Petroleum coke is used principally as fuel or, after calcining, for carbon electrodes. The sulphur content of petroleum coke is governed by the grade of crude oil from which it is produced, and all petroleum cokes are characterized by low total ash contents.

PETROCHEMICAL FEEDSTOCK[a] - Hydrocarbons which are to be charged to any process equipment or used as a raw material for a product.

PROCESS ENERGY[e] - Energy used in the direct production of a commodity or service, excluding such indirect energy inputs as energy used to process or transport raw materials and to construct factories and equipment. In an energy audit, the process energy requirement is useful in comparing the energy implications of alternative processes to determine where energy conservation methods can best be applied.

PROVEN RESERVE[a] - An estimation of real fuel resource based on an adequate control of subsurface information to verify that resource, and based on existing technology and current economic and social conditions.

PUMPED STORAGE ELECTRIC GENERATING CAPACITY[b] - An arrangement whereby additional electric power may be generated during peak load periods by hydraulic means using water pumped into a storage reservoir during off peak periods.

RESIDUAL FUEL OIL[a] - The heavy residue of petroleum that remains after lower boiling fractions are distilled. It is used primarily for generating electricity in industry and large commercial buildings. (See also FUEL OIL.)

SELF-HELP GAS[a] - Natural gas that is produced from industry-owned wells and delivered from the wellhead to an industrial plant via private pipeline. Industries' payment of transmission charges is one condition of this statewide program.

SOURCES:

[a] The Ohio Department of Energy.

[b] Edison Electric Institute. Glossary of Electric Utility Terms. New York: Statistical Committee of the Edison Electric Institute, 1977.

[c] Code of Federal Regulations, (CFR) Chapter II, section 450.11.

[d] Parker, Sybil P., ed. McGraw Hill Encyclopedia of Energy. New York: McGraw-Hill Book Company, 1981.

[e] Crabbe, David, and McBride, Richard. The World Energy Book. New York: Nichols Publishing Company, 1978.

OHIO DEPARTMENT OF ENERGY
RESPONSE TO A-95 REVIEW COMMENTS

Pursuant to the requirements of the Ohio Revised Code, the draft of the 1982 Ohio Energy Status Report was submitted to 19 reviewing agencies through the State Clearinghouse.

As of the required date of filing this Report with the Governor and the Ohio General Assembly, comments have been received from one reviewing agency, a copy of which has been made part of this final report.

The comments received from this reporting agency noted no exception to the report and our suggested course of future action. In fact, the report received suggested we proceed with application for funding the actions suggested herein.

As subsequent reports from reviewing agencies are received, they will be made a part of the permanent record and will be available at the offices of the Ohio Department of Energy, 30 East Broad St., 34th Floor, Columbus, Ohio

SEP 3 1982

CHAIRMAN
EDWARD E. ROGERS

25 W. PLEASANT ST.
SPRINGFIELD. OHIO 45506

CLARK COUNTY
PLANNING COMMISSION

DIRECTOR
JOSEPH A. TANYI

(513) 325-4665

August 31, 1982

Mr. Frank A. Hildebrand
Ohio Department of Energy
Division of Forecasts and
 Information
30 East Broad Street, 34 Floor
Columbus, Ohio 43215

Dear Mr. Hildebrand:

Re: 1982 Energy Status Report
SAI # 32-001-0022

Our office has conducted an in-staff A-95 review of the above referenced application for federal funds. This application has been endorsed as consistent with local and regional plans, and is not in conflict with any existing programs. You are, therefore, urged to continue with the submission of this application.

Sincerely,

Joseph A. Tanyi
Planning Director

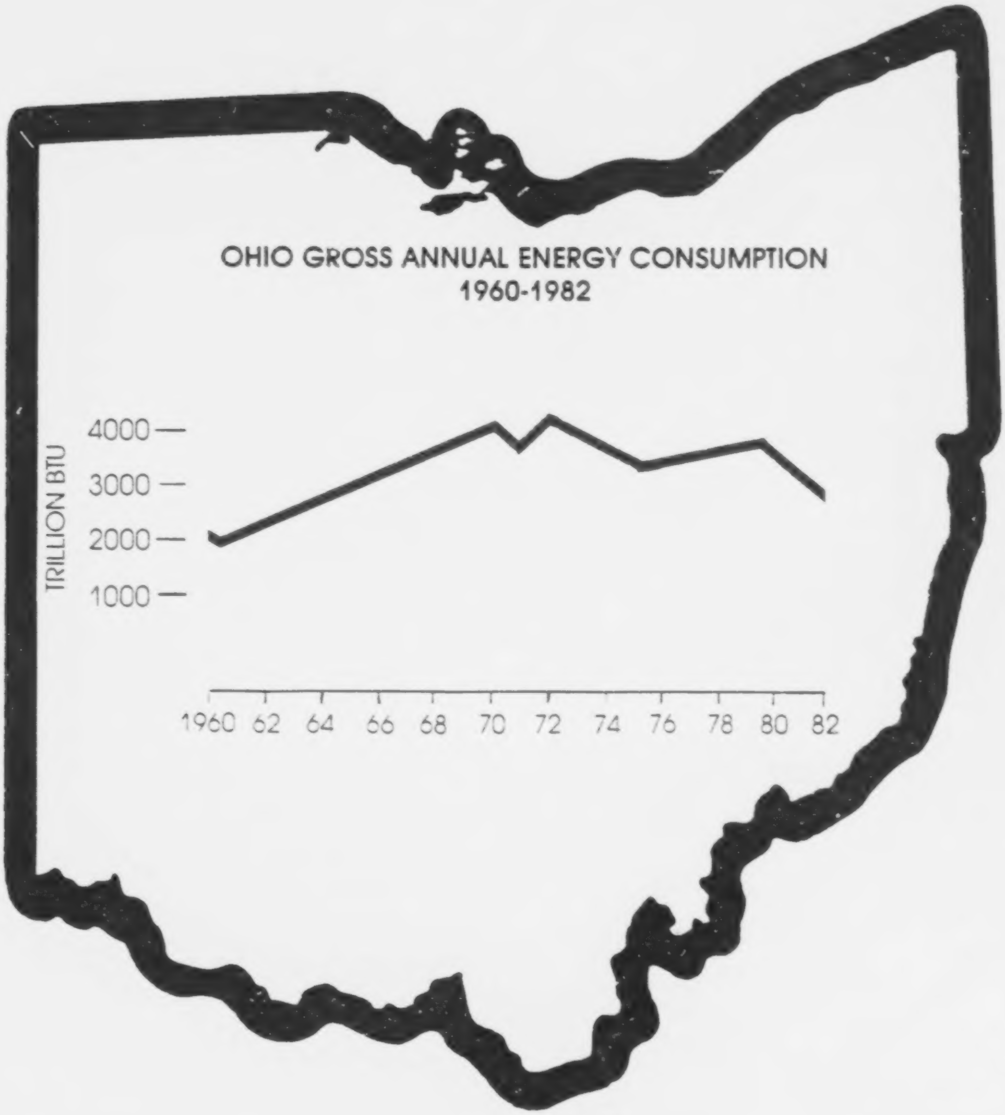
cs

cc State Clearinghouse

[redacted]

3/26/84 D6260-5(U)A-

1983 OHIO ENERGY STATUS REPORT



State of Ohio
Richard F. Celeste, Governor

Ohio Department of Development
Division of Energy
Alfred S. Dietzel

STATE OF OHIO
OHIO DEPARTMENT OF DEVELOPMENT
DIVISION OF ENERGY

Published March 1, 1984
For clarification of any statistics or further information,
contact the information support office at
(614) 466-1805

Richard F. Celeste, Governor
Alfred S. Dietzel, Director

STATE OF OHIO
Richard F. Celeste, Governor
Alfred S. Dietzel, Director

Department of Development
P.O. Box 1001 • Columbus, Ohio • 43216-1001

The Honorable Richard F. Celeste
Governor, State of Ohio

The Honorable Harry Meshel
President, Ohio Senate

The Honorable Vernal G. Riffe
Speaker, Ohio House of Representatives

The Honorable Gene Branstool
Chairman, Ohio Senate Energy & Utilities Committee

The Honorable Thomas P. Gilmartin
Chairman, Ohio House Energy & Environment Committee

Gentlemen:

In accordance with the provisions of Section 1551.04(E) of the Ohio Revised Code, I am pleased to submit the Annual Ohio Energy Status Report. This Report assesses emerging trends in Ohio energy supply, demand, conservation and cost and their implications for Ohioans.

Reliable and affordable energy supplies remain important to Ohio's economic growth. Energy cost increases which outstrip Ohioans' ability to pay or which inhibit the productive, competitive efficiency of Ohio business and industry are harmful to the State's economy. Continued excessive dependence on expensive remote energy supply sources misdirects Ohio dollars which could be better invested in creation of new jobs within Ohio. However, opportunities are at hand to make more efficient use of our energy supplies through enhanced conservation and greater reliance upon Ohio produced fuels.

Various private sector efforts are directed toward realization of these Ohio energy opportunities. Over time, such efforts in combination with thoughtful state policy and program initiatives will lead to energy's becoming a strengthened support to a competitive, high employment Ohio economy.

Sincerely,

Alfred S. Dietzel
Director

DAB:MPK:rd

30 East Broad Street (614) 466-2480

EXECUTIVE SUMMARY

Reliable and affordable energy supplies remain important to Ohio's economic growth. Energy cost increases which outstrip Ohioans' ability to pay or which inhibit the productive, competitive efficiency of Ohio business and industry are harmful to the State's economy. However, opportunities are at hand to make more efficient use of our energy supplies through enhanced conservation and greater reliance upon Ohio produced fuels.

Various private sector efforts are directed toward realization of these Ohio energy opportunities. Over time, such efforts in combination with thoughtful state initiatives will lead to energy's becoming a strengthened support to a robust, competitive Ohio economy.

Ten years have passed since the Arab Petroleum Embargo. Over this period, Ohioans experienced five major energy price and supply shocks:

1. 1973-74 Arab Embargo, which tripled the world price of crude oil and doubled consumer petroleum product prices in a matter of months.

2. 1975-1979 Natural Gas Shortages, which resulted from insufficient interstate gas pipeline supplies to serve Ohio gas utility customers during winter months.

3. 1979 OPEC Doubling Crude Oil Prices, triggered by the Iranian Revolution, caused unexpected petroleum product price increases, supply dislocations, and lines at retail gasoline stations.

4. 1979-1983 Tripling of Natural Gas Prices, triggered by the Federal Natural Gas Policy Act of 1978.

5. 1981-1983 Oil Price Decontrol and Market Price Stabilization, which ended federal price and supply controls and returned petroleum products to wider availability and moderate price fluctuations.

The driving force of Ohio's energy dynamics in the 1980's is price: the continuing high price paid by all consumers for energy, the growing inability of lower income consumers to pay, and the added pressure of higher energy costs on commercial and industrial consumers where profitability is already marginal and capital for new jobs investment is scarce. High energy prices represent an important challenge to this state's predominately energy intensive industrial economy to which adequate energy supplies have always been vital. Thus, energy availability and affordability remain crucial to a strengthened Ohio economy and higher employment levels.

During the current economic recession, all Ohio energy consuming sectors--residential, commercial, and industrial--have had difficulty in adjusting to steeply rising energy prices. In the 1980's Ohio will remain acutely sensitive to energy prices. First, Ohio will continue to have a high percentage of lower income households. Second, the capital stock of Ohio's energy consuming homes, buildings, industrial plants and equipment remains relatively old and energy inefficient compared to national averages. It takes more energy to heat a home or produce a ton of steel in Ohio than the national average. Third, Ohio's economy will be based on very energy intensive manufacturing industries, which need reliable, reasonably priced energy to make products which compete in national and international markets. Ohio's economy continues to be more dependent on manufacturing than the nation as a whole, accounting for about one-third of Ohio's overall Gross State Product in 1982.

Several current major Ohio energy issues affect Ohio energy consumers, providers, and public agencies as they continue responding to energy costs rising faster than their incomes. The common interest of all Ohio sectors is further reduction in energy operating costs.

1) Energy conservation has become Ohio's most cost-effective energy resource. However, capital and loan sources to initiate conservation are limited. In many cases, the cheapest source of the next Btu of energy for an Ohio consumer is energy saved through conservation. Between 1972 and 1982, Ohio's overall energy consumption per dollar of Gross State Product decreased 15 percent. In fact, Ohio industry, the state's largest energy consuming sector, now uses 40 percent less energy for each dollar of output product than in 1972.

2) Rising energy prices have resulted in the availability of a wider variety of energy products and services. Ohio consumers who have the financial ability can now purchase solar and geothermal heating for their homes, contract for lower-priced Ohio self-help gas for their schools and factories, generate their own electric power, and sell any excess power generated to an electric utility. They can contract to have building energy control systems and equipment installed at no capital cost to themselves through "shared savings" agreements with local energy management companies. In order to cut costs and to assure more control over future fuel supplies, industrial users in particular have investigated multiple fuel use systems, waste steam recovery, and direct purchase of natural gas.

3) Public/private cooperative programs are now being used to finance, market, and deliver Ohio energy products and services. For example, the Ohio Energy Action Corporation formed in 1983 will offer subsidized interest loans for energy conservation to lower- and moderate-income households. The Ohio Department of Development also uses innovative financing and assists in structuring projects which use Ohio energy resources.

4) Increasing public accountability by Ohio gas and electric utilities will continue to help keep consumers' utility costs down and to maintain Ohio industry's competitiveness. In particular, the source and price of Ohio utilities' gas and coal supplies have become important public concerns.

One way to do this is through more extensive use of management audits which examine utility management practices to see how well they provide adequate and reliable service to consumers at the least cost. A second means of increasing public accountability is through extensive review of and public hearings on the long-range plans of utilities for future plant and fuel needs.

5) Federal legislation and regulations provide much of the context within which Ohio energy producers, utilities, regulators and consumers operate. Though decontrolled prices for new natural gas were deemed necessary by Congress in 1978 to stimulate exploration for and development of new gas supplies, today there is an oversupply of natural gas for the foreseeable future. Serious concern exists nationally whether wellhead gas prices should now be decontrolled at the end of 1984. It is clearly not in the best interest of Ohio to allow "old gas" to be decontrolled, as that would allow higher prices to be charged with no increase in new production.

Current legislation also before Congress to require interstate gas transmission pipelines to contract for transporting user-owned gas will help large Ohio gas users, including schools and hospitals, and Ohio distribution utilities to shop for now available lower-priced supplies. Such legislation would benefit all gas customers, including residential customers.

6) Ohio's own production of energy has been a premier economic growth sector. However markets are now constrained. Ohio's extensive energy resource base of coal, natural gas, and biomass can contribute far more of the energy we will need in Ohio at competitive market prices. Already, Ohio energy production contributes the equivalent of 36 percent of all energy consumed in Ohio, compared to 33 percent in 1972. This is the same portion of Gross State Product (GSP) as tires, rubber, and petrochemicals combined.

Even with the current constraints, the dollar value of Ohio energy production has increased almost sevenfold since 1972. By working to overcome the constraints which presently exist, significant benefits to the state can be achieved, leading to additional jobs and access to more reasonably-priced energy sources for Ohioans.

Understanding where Ohio has been in energy over the past 10 years and appears to be going will greatly assist both public and private sector leaders in setting their respective policies and programs for energy in the 1980's. This knowledge can lead to formulation of programs to strengthen energy's support of the Ohio economy.

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INTRODUCTION: OHIO'S ECONOMY IS ENERGY SENSITIVE

Ten years have passed since the Arab Petroleum Embargo. Over this period, Ohioans experienced five major energy price and supply shocks:

o 1973-74 Arab Embargo, which tripled the world price of crude oil and doubled consumer petroleum product prices in a matter of months. The Embargo also caused severe initial shortages in key products, such as heating oil, and comprehensive federal supply allocation and price controls which lasted until early 1981. Consequently, oil supply markets and Ohio consumers experienced jolting dislocations in petroleum fuel uses and prices.

o 1975-1979 Natural Gas Shortages, which resulted from insufficient interstate gas pipeline supplies to serve Ohio gas utility customers during winter months. State approved utility curtailment plans restricted gas supply deliveries to lower priority uses, such as industrial boiler fuel, since such uses are normally convertible to fuel oil or propane.

o 1979 OPEC Doubling Crude Oil Prices, triggered by the Iranian Revolution, caused unexpected petroleum product price increases, supply dislocations, and lines at retail gasoline stations.

o 1979-1983 Tripling of Natural Gas Prices, triggered by the Federal Natural Gas Policy Act of 1978. NGPA decontrolled the wellhead price of gas from certain categories of wells and allowed other categories to rise in tandem with unexpectedly sharp oil price increases from 1979 to 1981. These steep price rises have caused severe hardship to the many lower income Ohio families and businesses which rely on natural gas as their principal fuel.

o 1981-1983 Oil Price Decontrol and Market Price Stabilization, which ended federal price and supply controls and returned petroleum products to wider availability and moderated price fluctuations. Petroleum product supply and price decontrol has caused major "structural" changes in Ohio industrial boiler fuel selection and consequent effects on competitor fuels, particularly natural gas.

Ohio industry's response to these unforeseeable events since the 1970's has been in several forms. Many industries have diversified their fuel sources and usage capabilities. Others have initiated rigorous fuel conservation measures and begun using fuels cheaper than utility-supplied natural gas.

Small commercial and residential users have most often been unable to make such large scale adjustments. Between 1972 and 1982, the average Ohio household was able to reduce its annual natural gas usage over 23 percent. However, the average Ohio family paid four times more in 1982 for home heating than in 1972. Energy costs as a portion of household and small business income more than doubled, as earnings lagged far behind energy price increases. Households and small businesses cannot easily switch to alternative lower priced fuels nor afford the full initial capital cost of extensive conservation measures.

These energy price increases have been felt most severely by lower income households, although this burden is somewhat reduced through state and federal low-income home heating cost assistance programs. In 1982, each of Ohio's nearly one-million lower income households spent on average more than $1500 on energy requirements. Consequently, lower income Ohioans continue to pay an average 20 percent of their income on energy, compared to less than 7 percent for moderate income and 2 percent for higher income Ohioans. Through 1982, lower income energy assistance programs have been disproportionately aimed at helping to pay heating fuel bills, rather than weatherizing lower income residences to use energy more efficiently. During 1982, over 120 million dollars in federal and state assistance were directed toward fuel bill vouchers as compared to $22 million in weatherization assistance.

In 1982, an estimated 16 percent of Ohio's Total Gross State Product, $21 billion, was spent directly on energy--compared to 10 percent in 1972. This is significant because we used 16 percent less energy in Ohio in 1982 than in 1972. Additionally, the sharp energy price rises of the 1970's have also raised the costs of consumer products which are energy intensive, such as synthetic fiber clothing, food, and plastic products of all sorts.

The driving force of Ohio's energy dynamics in the 1980's is price: the continuing high price paid by all consumers for energy, the growing inability of lower income consumers to pay, and the added pressure of higher energy costs on commercial and industrial consumers where profitability is already marginal and capital for new jobs investment is scarce. High energy prices represent an important challenge to this state's predominately energy intensive industrial economy to which adequate energy supplies have always been vital. Thus, energy availability and affordability remain crucial to a strengthened Ohio economy and higher employment levels.

During the current economic recession, all Ohio energy consuming sectors--residential, commercial, and industrial--have had difficulty in adjusting to steeply rising energy prices. In the 1980's Ohio will remain acutely sensitive to energy prices. First, Ohio will continue to have a high percentage of lower income households. Second, the capital stock of Ohio's energy consuming homes, buildings, industrial plants and equipment remains relatively old and energy inefficient compared to national averages. It takes more energy to heat a home or produce a ton of steel in Ohio than the national average. Third, Ohio's economy will be based on very energy intensive manufacturing industries, which need reliable, reasonably priced energy to make products which compete in national and international markets. Ohio's economy continues to be more dependent on manufacturing than the nation as a whole, accounting for about one-third of Ohio's overall Gross State Product in 1982.

Thus, both in direct energy use costs and through indirect effects on consumer prices, the energy price rises of the 1970's continue to create serious energy concerns for Ohioans in the 1980's. These include:

(1) high interstate gas prices and their relative insensitivity to reduced consumer demand;

(2) greater diversity in consumer fuel choices;

(3) assistance to lower income energy consumers;

(4) increasing the efficiency with which we use energy in Ohio;

(5) development of Ohio's own energy supply resources; and

(6) continued preparedness to cope with severe, unpredictible energy shortages.

Throughout the 1980's, manufacturing will continue to account for over 30 percent of the state's economy, and individual Ohioans will continue to devote a large portion of household income to energy expenses. Thus, reliable sources of energy, their costs and usage efficiency will remain critically important to Ohio's economic well being.

OVERVIEW OF OHIO ENERGY CONSUMPTION PATTERNS AND TRENDS

Overall Statewide Fuel Use and Costs

Ohio consuming sectors as a whole used 16 percent less energy in 1982 than in 1972. Ohio is about twice as dependent overall on coal (43 percent) than consumers nationally (22 percent). The overwhelming portion of Ohio's coal dependence (72 percent) is through usage of electricity which is 97 percent generated with coal. The remaining fuel dependence of Ohio consumers is split among petroleum based fuels (32 percent); natural gas (23 percent); and nuclear, hydro, solar and other (less than 1 percent). While coal dependence has remained fairly constant at 41-43 percent over the 1972-1982 period, natural gas consumption has declined from 30 percent to 23 percent. Conversely, dependence on petroleum fuels has increased from 29 percent to 32 percent.

Total Ohio Energy Consumption Shares

Fuel	1982	1972	Change
Natural Gas	23%	30%	-7%
Petroleum	32%	29%	+3%
Coal	43%	41%	+2%
Nuclear & Hydro	1%	0%	+1%

Consuming sector demand for coal overall is fairly constant. Of note, however, is that Ohioans are 8 percent more dependent on petroleum than before the Arab oil embargo. The state is 25 percent less dependent upon natural gas due to consumer conservation, the nonavailability of gas for new users and buildings between 1972 and 1979, and switching by many industrial users from gas to lower priced petroleum fuels since 1980.

Ohio Sectoral Energy Consumption Shares

Sector	1982	1972	Change
Industrial	37%	48%	-11%
Residential	22%	23%	-1%
Commercial	14%	13%	+1%
Transportation	27%	16%	+11%
	100%	100%	

Interestingly, while Ohio industrial users were 45 percent of all usage in 1972, industry nationally was only 32 percent of total consumer usage. In 1982, in both Ohio and the U.S. industrial share was 37 percent. This amounts to an 8 percent decrease in Ohio, compared to a 5 percent increase for the U.S.

Although Ohio's energy consumption per dollar of economic product in 1982 of $59.4 was 9 percent higher than the U.S. average, it was lower than that of California ($63.4), Indiana ($71.4), and Texas ($81.3). Per capita energy consumption for Ohio was greater than the national average in both 1972 and 1981, the last year for which data is available, although less than Indiana, California, and Texas.

Per Capita Energy Consumption

	1981	1972
Ohio	371 MMBtu	386 MMBtu
Massachusetts	209	273
Indiana	430	468
Pennsylvania	312	562
California	465	355
Texas	562	601
o United States Average	323 MMBtu	342 MMBtu

Implications. Even with the effects of the current severe recession on Ohio's industry, industry as a whole nationally is using a greater proportion of total energy than in Ohio. Several reasons for this are:

1) Increased energy use efficiency by existing energy-intensive Ohio industry has been accompanied by little growth in new Ohio capacity in the steel, glass, petrochemical, tires and plastic industries.

2) New plants in energy intensive industries have located in other states, such as Texas.

3) Many Ohio steel, tire, glass, and other energy intensive plants have closed or reduced operations.

Although Ohio's economy continues to be dependent upon manufacturing, growth in energy intensive industries is occurring elsewhere. On a per capita basis, Ohio still uses more energy than the national average. However, new industrial plant expansion and air conditioning penetration in the Sun Belt States has moved the national average closer to Ohio's energy use per capita.

Ohio Sectoral Consumer Energy Prices
(Nominal Dollars per Unit)

	1982	1972	Change
Residential:			
Natural Gas (mcf)	$4.65	$1.05	+343%
Electricity (kWh)	0.0676	0.0238	+284%
Heating Oil (gallon)	1.13	0.18	+527%
Kerosene (gallon)	1.15	0.20	+475%
Propane (gallon)	0.85	0.19	+348%
Commercial:			
Natural Gas (mcf)	4.39	0.89	+393%
Electricity (kWh)	0.0647	0.0219	+393%
Heating Oil (gallon)	1.04	0.15	+593%
Industrial:			
Natural Gas (mcf)	4.07	0.64	+536%
Electricity (kWh)	0.0475	0.0101	+370%
Heating Oil (gallon)	0.98	0.11	+791%
Residual Oil (gallon)	0.71	0.11	+545%
Coal (ton)	36.54	14.76	+148%
Transportation:			
Gasoline Retail (gallon)	1.19	0.38	+213%
Diesel Retail (gallon)	1.00	0.19	+426%

Beween 1972 and 1982 for all fuels and all sectors, energy costs to Ohio consuming sectors rose significantly faster than the overall cost of living. Ohioans now spend nearly 16 percent of total Gross State Product on energy compared to 10 percent in 1972. Energy costs for smaller Ohio businesses and households are now twice the portion of their annual income they were in 1972. Further increases in conservation in all sectors are constrained by the fundamental design inefficiencies of Ohio's relatively older housing, building and physical plant stock. Efficiency improvements will require major structural and energy system replacements as well as new sources of capital to undertake them.

Ohio Residential Sector

Ohio's residential consumers remain over three times as dependent on natural gas than any other energy source. Natural gas in 1982 provided 65 percent of total residential energy needs compared to 70 percent in 1972, while electricity provided 20 percent (up from 12 percent in 1972), petroleum based fuels provided 12 percent (down from 15 percent in 1972), and coal, solar and other fuels remained about 3 percent. However, direct residential coal usage declined by 49 percent while solar, wood and renewable resource use nearly doubled.

Ohio Residential Energy Consumption Shares

Fuel	1982	1972	Change
Natural Gas	65%	70%	-5%
Electricity	20%	12%	+8%
Petroleum Fuels	12%	15%	-3%
Coal, Solar & Other	<3%	<3%	0%
	100%	100%	

Implications. Residential demand for natural gas and petroleum fuels declined, while electricity demand rose for several reasons:

(1) The preponderance of residential fuel conservation savings has been in space heating, for which gas was and is the primary residential fuel;

(2) Between 1972 and 1979 no new residential gas hook-ups were allowed due to utility shortages of gas for existing on-line customers. Consequently, the majority of new residential dwellings built in this period used electricity for space and water heating; and

(3) Increasing residential market penetration by air conditioning and electrical home appliances such as frost free refrigerators, dishwashers and microwave ovens--all very heavy electricity users--increased residential electricity demand. This trend will continue.

Total average annual residential energy costs increased from \$1.89/MBtu in 1972 to \$6.37/MBtu in 1980. Adjusting for inflation, average residential energy costs still rose 100 percent--far faster than household incomes. Average annual natural gas heating costs increased from \$1.05/mcf in 1972 to \$4.65/mcf in 1982, even though the average residential consumer used 25 percent less gas.

Primarily due to a more than fourfold increase in utility natural gas rates, the percentage of household income devoted to energy costs more than doubled. Lower income Ohio households now devote an average 20 percent of income to energy costs, compared to less than 7 percent for middle income households.

Ohio Commercial Sector

This sector includes all non-industrial business and commerce, along with government, educational, and health users. Commercial consumers remain almost twice as dependent on natural gas as upon any other energy source. Natural gas in 1982 provided 48 percent of total commercial energy needs compared to 54 percent in 1972, while electricity provided 27 percent (up from 17 percent in 1972) and petroleum fuels provided 24 percent (down from 26 percent in 1972). About two-thirds of commercial sector petroleum usage has consistently been asphalt which is used primarily for road paving. Commercial usage of coal declined about 40 percent from 1972 to 1982. Solar, wood and other renewable energy were insignificant sources (less than 1 percent) during this period.

Ohio Commercial Energy Consumption Shares

Fuel	1982	1972	Change
Natural Gas	48%	54%	- 6%
Electricity	27%	17%	+10%
Petroleum Fuels	23%	26%	- 2%
Coal, Solar & Other	2%	3%	- 1%
	100%	100%	

Implications. While natural gas remains the predominant commercial heating and cooking fuel, commercial gas usage declined by 13 percent from 1972 to 1982. This means that in addition to losing substantial new commercial use market share to electricity due to the 1972-79 new gas connection ban, natural gas also lost a sizable portion of existing 1972 commercial consumer energy demand over this period. On the other hand, overall commercial sector use of electricity is expected to continue its recent 3 percent annual growth over the 1980's.

Many large commercial users, such as department stores, supermarkets, shopping malls, school systems, hospitals, and office buildings have initiated rigorous light, space heating and water heating energy consumption reduction measures. This trend will continue, with no significant increase in commercial natural gas use foreseen in this decade.

Ohio Industrial Sector

Industry remains Ohio's largest fuel consuming sector. Coal remains the predominant, but much reduced, direct energy source for Ohio industrial consumers. Coal in 1982 provided 33 percent of total industrial needs compared to 42 percent in 1972, while natural gas provided 26 percent (compared to 29 percent in 1972). Hence, both coal and natural gas have lost substantial industrial market shares to electricity (16 percent, up from 11 percent in 1972) and to petroleum fuels (25 percent, up from 18 percent in 1972). Industrial use of solar, wood and other renewable energy sources was insignificant during this period. However, energy resource recovery of industrial "waste products", such as steam, wood chips, etc. has increased. For some industrial users waste energy recovery is now a significant, cheap energy source.

Ohio Industrial Energy Consumption Shares

Fuel	1982	1972	Change
Natural Gas	26%	29%	- 3%
Electricity	16%	11%	+ 5%
Petroleum Fuels	25%	18%	+ 7%
Coal	33%	42%	- 9%
Solar & Other	< 1%	< 1%	
	100%	100%	

Two significant industrial energy trends occurred during this period:

(1) Ohio industry became much more energy efficient. Between 1972 and 1982 overall Ohio industrial energy consumption declined sharply by 34 percent. However, the real value in constant dollars of Ohio industrial output increased by 10 percent in this period. This means that despite the effects of economic recession, Ohio industry has been able to use over 40 percent less energy for each dollar of output product in 1982 than in 1972.

(2) Ohio industry has become more broad-based in its fuel source dependence. In the mid-1970's, industry was forced to employ rigorous natural gas conservation measures due to utility supply curtailments. Ohio industry reacted by:

(a) cutting out nonessential gas uses;

(b) installing new equipment to use petroleum based fuels;

(c) procuring, and even producing, their own non-utility source fuels such as self-help natural gas and recovered steam heat "waste".

Implications. In order to remain competitive in national and international markets, Ohio industry must continue to increase its productive efficiency, including further cutting in all categories of operating costs. Energy remains a very major industrial plant operating cost. In addition to cutting the energy inputs needed for each dollar of product, Ohio industry will continue to seek the cheapest sources for the energy they need. This means use of high priced utility supplied natural gas as a last resort only when cheaper heating oil, propane, "waste energy", and self-help natural gas are unavailable. Industry will aggressively seek its own more self-controllable and price-predictable sources. In 1982, non-utility self-help gas already provided over 10 percent of Ohio industry's gas supply, compared to none in 1972.

Energy intensive Ohio industries such as steel, fabricated metals, glass, stoneware and petrochemicals will remain quite sensitive to energy costs and supply source reliability. High energy operating costs have already become a significant factor in some corporate decisions on location of new or expanded industrial plants.

While utility-provided industrial electricity consumption can be expected to rise slightly faster than the general rate of Ohio economic growth, growth in utility-provided natural gas consumption will be minimal. However, it does seem clear that:

(1) Significant further increases in industrial in-plant energy usage cost containment can come only from major plant modernization and substantial capital investment;

(2) Therefore, it is more economical in the short term for Ohio industry to increasingly seek cheaper fuel source alternatives, especially boiler fuels cheaper than utility provided natural gas. Since 1972 self-help gas and petroleum fuels have already replaced over 20 percent of gas utilities' historic Ohio industrial market share, seemingly on a permanent basis.

Ohio Agricultural Sector

Ohio's agricultural sector energy supplies and consumption are included in the much larger industrial sector described above. However, the agricultural sector is so important to Ohio's economy and its energy concerns so special it warrants separate discussion.

Ohio agriculture is heavily dependent on gasoline and diesel fuel for operating farm equipment, natural gas and propane for crop drying, and on petroleum products which are used extensively as raw materials in fertilizer, pesticide, and herbicide production. Ohio crops such as soybeans and corn require large energy inputs for fertilization, cultivation, and drying before storage. In 1981, 50 percent of the direct energy consumed by Ohio agricultural operations was natural gas, 19 percent was gasoline, 16 percent was diesel fuel, 8 percent was electricity, and 7 percent was liquid petroleum gas.

Ohio agriculture is extremely sensitive to uncertain costs of natural gas for (1) fertilizer and (2) greenhouse heat. Actually, Ohio agriculture is more than 50 percent dependent on natural gas, as natural gas accounts for over half the cost involved in fertilizer production. Therefore, Ohio agricultural users remain very sensitive to rising or uncertain natural gas prices during the present period of variable farm product and produce prices. This is particularly important to Ohio's greenhouse industry which currently has about 20 percent of the total U.S. greenhouse acreage under cultivation, second only to California.

Implications. Rising fertilizer, heating and crop drying fuel costs, if not accompanied by increased corn, soybean and other energy-intensive product prices, could hurt smaller agricultural operations and lead to changes in larger operations' crop mix. The recent interest of Ohio's agricultural sector in producing alcohol fuels from Ohio corn and other grains typifies this sector's long-term interest in finding more self-manageable, cost-controllable sources of energy, as well as more certain, stable product markets. This trend will continue.

Ohio Transportation Sector

Ohio's transportation sector is composed of common carriers of freight and passengers, business, commercial, and governmental vehicles; and private individuals' automobiles, trucks, watercraft, and airplanes. Petroleum based fuels account for over 99 percent of all transportation energy sources. Gasoline provides 80 percent of this, diesel fuel 14 percent, and jet fuel 4 percent. Electricity, natural gas, propane, and residual oil collectively provide less than 2 percent.

Ohio Transportation Energy Consumption Shares

	1982	1972	Change
Gasoline	80%	80%	-0-
Diesel	14%	13%	+1%
Jet Fuel	4%	5%	-1%
Propane	< .1%	< .1%	-0-
Residual Oil	< 1%	< 1%	-0-
Total Petroleum	99.2%	98.6%	+.6%
Natural Gas	.8%	1.4%	-.6%
Electricity	< .1%	< .1%	-0-
	100%	100%	

Ohio's transportation sector has become more fuel efficient, but the number of miles traveled has increased by about the same percent. Average vehicle miles traveled have increased 13 percent from 1972 to 1982 while average miles per gallon of fuel increased from 12.13 to 13.98, or 15 percent.

Overall Ohio transportation fuel usage has declined 7 percent since 1972. Usage has declined since the 1973 Arab Oil Embargo and the onset of significant transportation fuel price increases. Miles driven annually have, in fact, increased slightly since the sudden 1979 OPEC redoubling of oil prices. However, this has been more than offset by significant miles per gallon vehicle efficiency improvements in recent years. The 1980 recession and rising automobile prices have undoubtedly caused Ohioans to keep their present vehicles longer. The average vehicle in Ohio is nearly one year older than the national vehicle stock average and is, therefore, slightly less fuel efficient than the national average.

Implications. The reduction by less than 10 percent in transportation fuel usage between 1972 and 1982 may seem somewhat surprising. Certainly petroleum fuels were the first of the major "energy shortages" in the 1970's and the first fuel to skyrocket in price. Moreover, vehicle stock tends to turn over almost totally within a 10 year period compared to residential, commercial and industrial building stock at 30 years or more.

This ten-year experience shows that Ohio transportation fuel use is somewhat less price sensitive than other uses, such as natural gas space heating and industrial processes. A fourfold increase in petroleum fuel prices has resulted in less than a 10 percent decrease in demand. However, upon closer examination, several points help explain this:

(1) Transportation users, being 99 percent petroleum fuel dependent, have no alternative fuel choices as do for example, industrial boiler users;

(2) As virtually all petroleum fuels are imported into Ohio, there have been and will be no "supply side" options for Ohio users; and

(3) Other than tune-ups and good driving habits, efficiency improvements in transportation vehicles remains much within the purview of vehicle manufacturers, through mpg improvements.

Newer vehicle fuel systems are becoming increasingly complex and "factory set". Therefore, fuel efficiency criteria in selection of the next vehicle purchased and good operating practices remain the major opportunities for transportation fuel cost control available to Ohioans.

OVERVIEW OF OHIO ENERGY SUPPLY SOURCES

Overall Ohio Supplies

Origins. In 1982, as in 1972, energy produced within the State provided slightly less than one quarter of total supplies. This overall constancy, however, belies some significant shifts in fuel source mix. Usage of Ohio coal within Ohio fell 23 percent, while utility and industrial markets for Ohio coal outside the State fell even more sharply. In 1982, Ohio coal's share of the Ohio coal market declined to 43 percent from 52 percent in 1972.

Ohio Energy Supply Source Shares
(As percent of total supply)

Fuel Source	1982	1972	Change
Ohio Coal	18.6%	21.1%	-2.5%
Ohio Natural Gas	3.4%	2.3%	+1.1%
Ohio Synthetic Gas	1.0%	0	+1.0%
Ohio Petroleum	<1.0%	<1.0%	0%
Ohio Hydro, Solar & Other	<1.0%	<1.0%	0%
o Total Ohio Produced Energy	24.0%	24.4%	- .4%
Non-Ohio Coal	24.5%	19.6%	+4.9%
Non-Ohio Natural Gas	20.7%	28.5%	-7.8%
Non-Ohio Petroleum	32.3%	29.9%	+2.4%
Non-Ohio Uranium	< 1.0%	0	<+1.0%
o Total Non-Ohio Sources	77.6%	78.0%	+ .4%

Conversely, Ohio natural gas production increased 52 percent over the same period. Virtually all Ohio's refined petroleum product supplies are derived from crude oil produced outside the state. While current crude supplies are more than adequate and prices are moderate, any future disruption in international crude oil supplies could cause recurrence of the kind of price and availability problems experienced in the 1970's. The uncertainities of international events leave Ohio no more or less vulnerable to future petroleum shocks than the nation as a whole.

Implications. Ohio coal and imported coal supplies will be adequate for many years. The major uncertainties lie in the question of whose coal will be used. Electric utilities account for 88 percent of Ohio coal usage. There is little probability of a shift away from coal itself by Ohio's largest users. Rather, the markets for Ohio produced coal remain demand-constrained due primarily to utility uncertainty regarding clean air compliance requirements. Until clarity prevails on this issue, no increase in demand for Ohio coal can occur. Moreover, there is a risk of further erosion in already depressed electric utility markets for Ohio coal if future air quality compliance plans dictate switching to lower sulfur, non-Ohio coals.

Natural gas supplies are more than ample. The current glut of interstate gas supplies, coupled with reduced consumer--especially industrial--demand, has led to a significant decline in imports of non-Ohio gas. The principal problem for Ohio gas utilities and the interstate pipelines who supply them is that in 1982 the price of gas supplies rose above the alternative price of other fuels for many Ohio industrial users. Increasing use of petroleum fuels and self-help gas by Ohio industry may result in substantial permanent loss of markets for Ohio gas utilities.

Providers. The trend, led by Ohio industrial users, is toward decreasing reliance by Ohio consumers on single energy provider sources. In 1982, self-produced or procured energy sources accounted for over 9 percent of consumers' supplies compared to less than 6 percent in 1972.

In addition to the final consumer's clear interest in gaining more direct control over their own energy sources, energy providers themselves are also becoming more self-reliant and diversified in their upstream supply sources. Ohio electric utilities have increased the amount of their coal supplies from their own mines and have a higher percentage of shorter term contracts and spot purchases from third party coal suppliers. Ohio petroleum marketers of gasoline, diesel fuel, and heating oil have also diversified their sources of refined petroleum products. Most Ohio marketers now have a second or even third upstream supplier of products.

The trend to greater both supplier and consumer diversity of supply sources is strong and is likely to continue throughout the 1980's. In response to energy consumer demands for greater flexibility in managing their own energy situation, two simultaneous supply market trends have arisen:

(1) Supply Market Consolidation. The numbers of Ohio producers of coal, oil, and gas and retailers of gasoline have significantly declined since 1972. There are now over 40 percent fewer Ohio coal

producers, and 25 percent fewer independent retail gasoline service stations. Ohio's ten largest coal producers now account for about 70 percent of Ohio coal production, though there are still about 200 Ohio coal production companies. In gasoline retailing, direct marketing by major oil companies and distributor marketers through their own retail outlets has increased. The average independently owned and operated gasoline service station now needs a monthly volume of 50,000 gallons to be competitively viable, compared to 25,000 gallons in the early 1970's.

This trend toward consolidation in energy marketing is consistent with trends in other areas, such as groceries, dry goods, drugs and sundries. However, with far fewer full-service retail gasoline stations, good auto maintenance has become more dependent on vehicle owner initiative.

(2) Supply Market Segmentation. The simultaneous trend is toward segmented marketing of specialized energy products and services to business and individual customers, and the Ohio energy marketing trend is to seek out select market segments.

Small coal producers and gasoline station operators cannot easily compete in marketing large volumes at low margins against much bigger competitors. Therefore, they have begun to redirect themselves to the select market segments which do want full automobile garage services and specially blended, clean coals for non-utility size boilers. Natural gas producers have arranged direct sales of gas to industrial customers. Some small gasoline retailers have recently begun issuing their own credit cards in hopes of attracting and retaining business customers who desire local credit and billing of purchases.

Implications. This trend toward both consolidation of large markets and segmentation of special markets in Ohio energy marketing will continue. However, severe problems remain for small Ohio energy providers for several reasons:

(1) The general economy's trend toward greater direct mass marketing by very large retailers leaves the small business provider with very little choice of remaining market segments who will pay more for special services or products;

(2) In gasoline retailing, a further 15-20 percent decline in overall consumer demand is expected over the 1980's as the on-the-road vehicle mix develops significantly higher mpg efficiency. This further decline in Ohio gasoline demand is not likely to come from the market share of high volume/low margin station operators. By the mid-1980's, an independently owned and operated service station may need monthly volumes of 75-100,000 gallons to remain viable. This trend

is not large oil companies crushing small business competition, but rather large volume operations outcompeting small ones. Large volume independents will undoubtedly do as well as similarly sized company owned stations;

(3) Coal markets are and will be demand constrained until greater clarity exists with respect to clean air requirements. While specially blended and cleaned Ohio coals can still find non-utility market niches, in the longer term all Ohio coal producers must have more accessible electric utility markets to remain viable; and

(4) Ohio natural gas markets are transportation constrained. While most Ohio gas produced and available at the wellhead is now indisputably cheaper than interstate gas, its availability to Ohio gas utilities and self-help users is constrained by lack of access to transmission facilities.

Average Ohio Supply Source Costs

	1982	1972	Change
Ohio Coal to Electric Utilities ($/ton)	38.04	6.67	470%
Non-Ohio coal to Electric Utilities ($/ton)	42.07	12.93	225%
Ohio Natural Gas at Wellhead ($/mcf)	2.71	.39	595%
Interstate Pipeline Gas to Ohio Distribution Utilities ($/mcf)	3.61	.58	522%
Ohio Crude Oil ($/barrel)	30.92	3.76	722%
National Crude Oil ($/barrel)	28.52	3.39	741%

Ohio Energy Resource Production. In 1982, the dollar value of Ohio coal, gas, oil and ethanol production was almost seven times greater than in 1972. While coal production volumes declined 23 percent, coal products' contribution to Ohio's economy increased by a factor of 4 to $1.2 billion. Oil and gas production dollar values increased by a factor of more than 10, on a volume increase of 54 percent.

Thus, by 1982 Ohio energy resource production had become a $2.5 billion dollar industry, tripling the sector's share of total Ohio GSP to almost 2 percent. By way of comparison, this is about twice the GSP contribution share of Ohio's rubber and tire producing sector and over half that of Ohio's steel industry.

Value of Ohio Energy Resource Production to State Economy[1]
(Energy Equivalent)

	1982	1972	Change
Ohio Production Volumes[1]			
Coal (10^6 tons)	38.9(899TBtu)	50.6(1164TBtu)	- 23%
Natural Gas (Bcf)	138.4(143TBtu)	90.5(93TBtu)	+ 53%
Syn. Gas (Bcf)	62.0(63TBtu)	0	-
Crude Oil (10^6 bbls.)	14.6(86TBtu)	9.4(55TBtu)	+ 55%
Eth. Alcohol (10^6 gall.)	12.8(1.3TBtu)	0	-
% of Total State Energy Use	35.6%	33.1%	
Ohio Production $ Value	(In Million Dollars)		
Coal	1249	301	+ 315%
Natural Gas	370	35	+ 957%
Synthetic Gas	370	0	-
Crude Oil	451	35	+1189%
Ethanol Alcohol Fuel	12	0	-
Total $$ Value	2452	371	
Energy Production as % of Ohio GSP	1.9%	.6%	

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[1] Includes Volumes and Dollar Values of Ohio Production for Export to Non-Ohio Markets.

Implications. Clearly, energy resource production has been one of Ohio's premier economic growth sectors durng the past decade. As noted above, current coal consumer environmental compliance concerns and gas transportation factors constrain near-term markets for Ohio produced energy. In addition to becoming a very important statewide economic growth sector, energy production is a major economic industry in many Southeastern and Eastern Ohio counties. Therefore, continued market demand stagnation for Ohio coal and wellhead transportation bottlenecks restricting Ohio oil and gas production could have devastating effects on local economies and employment levels in many of these Ohio counties.

In addition to the importance of Ohio energy production's direct dollar value to the state's economy, greater Ohio energy production will keep more dollars within this state for investment in new employment opportunities at the local level. For example, in recent years, Ohio electric consumers have been paying over $40 million dollars annually in coal taxes to other states which go to fund their public services, schools, and coal research programs. In 1982, over $1 billion was spent by Ohioans for out-of-state coal. Ohio's expenditures on natural gas have increased from $786 million in 1970 to $2,986 million in 1980 - an increase of 280 percent, according to figures from the U.S. Energy Information Administration. While the percentage of Ohio produced gas has increased during this period, the great bulk of Ohioans' expenditure for gas still goes for supplies imported from other states

Increased reliance on Ohio coal and other Ohio-produced energy resources will keep substantial dollars within Ohio's economy for investment in new jobs and business expansion.

Electricity Sources

Ohio electricity utilities continue to remain over 95 percent dependent on coal for power generation. Ohio utilities purchase 82 percent of all steam coal used in Ohio. While Ohio utilities' total use of coal has increased more than 13 percent since 1972 from 40 million to 45 million tons annually, Ohio coal's utility market share has declined sharply. In 1982, Ohio produced coal filled only 50 percent (23 million tons) of Ohio utility coal 45-million-ton requirements, compared to 66 percent in 1972. More than 80 percent of Ohio utilities' out-of-state coal comes from Kentucky and West Virginia. In 1982, Ohio electric utility customers paid $47 million in coal severance taxes to other states, compared to $1.2 million to Ohio.

Ohio Electric Utility Fuel Sources
(% of total supply)

Source	1982	1972	Change
Ohio coal	50%	66%	-16%
Non-Ohio coal	47%	32%	+15%
Natural Gas	.1%	1%	-1.0%
Petroleum Fuels	<.1%	1%	-1.0%
Nuclear	3%	0%	+3.0%
	100%	100%	

With respect to generating capacity, Ohio electric utilities have adequate reserve generating margins through at least the early 1990's.

State Aggregate
Electric Generating Capacity
(Megawatts)

	1982	1972
Peak Consumer Demand[a]	22,678	19,790
Total Reserve[b]	10,871	3,335
Reserve Margin	48%	17%

NOTES: [a] Ohio portion of highest seasonal internal load of 11 major electric utilities.

[b] Ohio portion of lowest seasonal reserve of 11 major electric utilities.

[c] Reserve margin = (Reserve/Internal Load) X 100

The U.S. DOE considers a reserve margin of 15-25 percent as adequate, while the Ohio Electric Utility Institute estimates an adequate reserve margin range to be 20-30 percent. This level of current utility plant reserve margins combined with utility forecasts of future Ohio consumer demand suggests that no new electric generating plants in addition to those currently operating or under construction will be needed by Ohio public utilities in this decade.

Implications. As Ohio currently has in place sufficient generating capacity to guarantee supply adequacy in the 1980's, decisions on siting new facilities will not be pressing for some time to come. However, a major concern will be whatever new sulfur emissions reductions Congress may mandate. Utility compliance will have significant operational impacts on Ohio electric power generation. Stack gas scrubbers added to existing plants will cost millions of dollars to construct, will require purchasing large quantities of lime to react with the sulfur, and will necessitate establishment of new landfills to dispose of the sludge produced by the chemical reaction between it and the flue gases.

Another important concern will be whether utility construction-work-in-progress (CWIP) should be passed on to consumers in any form before such facilities are fully completed and operating. The Celeste Administration has supported eliminating CWIP charges to prevent forced subsidies from customers for unnecessary power plant construction.

All State and Federal proposals bearing on electric utilities must be analyzed for direct consumer impacts through their effects upon Ohio generating capacity, reserves, operations, and costs.

Natural Gas Sources

Natural gas supplies are more than adequate for estimated Ohio consumers' needs throughout the 1980's.

Ohio Gas Sources and Suppliers

Sources:[2]	1982[1]	1972[1]	Change
Ohio Produced Natural Gas[2]	114(14%)	73(6%)	+56%
Green Springs Synthetic Gas[2]	33(4%)	0(0%)	-
Interstate Pipeline Gas	672(82%)	1128(94%)	-40%
Total Ohio Sources	819[3]	1201[3]	-31%

Providers	1982	1972	Change
Gas Utilities	763(95%)	1159(100%)	-34%
Self-Help/Direct Purchase	38(5%)	0	-
Total Provided	801[3]	1159[3]	-31%

[1] In Billion Cubic Feet (Bcf).

[2] Net of Ohio Production sold for delivery out-of-state.

[3] Difference = storage, line losses, and utility use.

Between 1972 and 1982 overall Ohio gas demand declined 31 percent. While interstate gas pipeline sources declined 40 percent, Ohio produced natural and synthetic gas sources increased 101 percent from 73 Bcf in 1972 to 147 Bcf in 1982. Consequently, 18 percent of Ohio 1982 gas supplies come from sources within the State, compared to only 6 percent in 1972.

One major exception to this supply source diversification trend is Columbia Gas of Ohio (COH). COH has informed the DOD Division of Energy that, having been 92 percent dependent on its sole interstate pipeline supplier in 1982, it plans to increase this sole source reliance to 96 percent by the late 1980's.

Implications. Most Ohio gas utilities are continuing to pursue supply source diversification. Such greater diversity in Ohio gas supply sources is important for several reasons at this time:

(1) Although there is currently an abundance of gas supplies nationally, it is prudent for Ohio gas utilities to rigorously pursue further diversification of future gas supply sources.

(2) Due to the present gas supply glut, there is a great deal of Ohio produced gas available for Ohio utility purchase at this time. The total current Ohio gas distribution utility purchases of Ohio produced gas in 1982 of 57 Bcf could easily be increased by 50 percent within several years. Much of this Ohio gas is available at prices significantly cheaper than from interstate pipeline suppliers; and

(3) Substantial purchases of cheaper Ohio produced gas offer Ohio utilities an opportunity to reduce their overall gas supply costs. This will enable Ohio gas utilities to offer lower customers' gas rates and to remain more competitive with petroleum fuels and self-help gas in important industrial baseload markets.

Self-help natural gas has provided large users, such as industrial plants, an alternative to more expensive utility supplied gas. Self-help began in the early 1970's when many Ohio industries foresaw utility supply shortages. Users bought gas directly from producers or brokers and arranged for utilities to deliver their gas from the wellhead to their industrial plant. Such self-help gas helped protect industrial users from utility imposed curtailments due to shortages of upstream interstate gas supplies.

The current very high cost of utility supplied gas and the availability of less expensive Ohio gas at the wellhead has generated renewed, greater interest in self-help gas. In addition to large industrial users, universities, school systems, and business development parks are now expressing strong interest. Ohio State University has recently entered into a long term self-help arrangement which will save several million dollars in future gas costs over the life of the project.

Implications. A lack of pipeline transportation from Ohio gas producing wells now seriously constrains both Ohio distribution utility and self-help user purchase and delivery of additional, cheap Ohio gas. Significant increases in reliance on Ohio gas sources are dependent upon opening access to the more than 4000 miles of Columbia Gas Transmission (TCO) pipelines within Ohio. These pipelines have unused capacity capable of moving Ohio gas to new purchasers.

This pipeline transportation constraint may be relieved should Congress act on contract or common carriage legislation. "Contract carriage" would require pipelines to enter into transmission agreements. "Common carriage" would mandate open lines to all who desire and can pay for transportation service. The effect of either would be increased availability of pipelines to carry Ohio produced gas to self-help Ohio purchasers, including industry, schools, and distribution utilities seeking cheaper gas supplies.

Coal Sources

Deliveries of coal to Ohio in 1982 were 62.2 million tons, of which 27 million (43 percent) came from Ohio and 35.2 million (57 percent) came from out-of-state. Out-of-state sources for utility steam coal were 26 million tons (52 percent), coming primarily from Kentucky and West Virginia. Out-of-state sources for metallurgical quality coal, which Ohio does not produce, were 7.3 million tons, almost all from Pennsylvania. Metallurgical coal is used mostly for coking purposes in the Ohio steel industry.

Ohio Coal Sources
(million tons)

	1982	1972	Change
Metallurgical Ohio Coal	0	0	--
Metallurgical Non-Ohio Coal	7.3	12.8	-43%
Ind. Comm. Ohio Steam Coal	3.3	7.2	-54%
Ind. Comm. Non-Ohio Steam Coal	2.3	5.5	-58%
Utility Ohio Steam Coal	23.7	27.9	-15%
Utility Non-Ohio Steam Coal	25.7	14.3	+80%
Total Ohio Sources	27.0	35.1	-23%
Total Non-Ohio Sources	35.2	32.7	+ 8%
Total Ohio Market Purchases	62.2	67.8	+ 8%

Ohio Coal Markets and Production
(million tons)

Markets	1982	1972	Change
Ohio Utilities	23.3	27.9	-16%
Ohio Industry & Commercial	3.7	8.0	-54%
Total Ohio Market	27.0	35.9	-25%
Non-Ohio Utilities	6.6	12.0	-45%
Non-Ohio Industry & Commercial	2.0	3.4	-41%
o Total Export Market	8.6	15.4	-44%
o Grand Total Ohio Coal Markets	35.6	50.3	-29%
Production Method			
Surface	24.9	34.3	-28%
Underground	14.0	16.3	-12%
Total Ohio Coal Production	38.9	50.6	-23%

Between 1972 and 1982, Ohio electric utility coal consumption increased 17 percent and their purchases of non-Ohio coal increased 80 percent. As can be seen from the table above all markets for Ohio coal have declined sharply since 1972:

Ohio utilities	-16%
Ohio industry & commercial users & retailers	-54%
Out-of-state markets	-44%

Overall, Ohio coal has lost 29 percent of its 1972 markets, representing nearly 15 million tons of annual coal production.

Implications. This stark decrease in Ohio coal production and markets is the result of energy consuming sectors switching to environmentally cleaner oil, gas, electricity and lower sulfur non-Ohio coal. There does appear to be a floor Ohio utility demand for Ohio coal of about 21-22 million tons, based on their 9 million tons of owned annual captive Ohio coal production and their long-term contracts with Ohio producers. In spite of this, depressed levels of Ohio coal market demand due to uncertainty of how more restrictive federal sulfur emissions limitations will affect utility ability to continue use of high sulfur Ohio coal.

Ohio Coal Markets

Two-thirds of the Ohio market is dedicated to long-term contracts, some lasting ten to twenty years. Loss of a potential sale to non-Ohio coal may mean the loss of that demand for years.

Erosion of Ohio coal's market since the early 1970's has been almost exclusively in two states; Michigan, and Ohio itself. Michigan markets for Ohio coal have fallen more than eight million tons, while Ohio's own demand has fallen nearly as much.

Contrary to common belief, little of this market has been lost to Western coal. Michigan now uses less than two million tons of Western coal per year, this as a result of a captive mine and transportation system owned by Detroit Edison. In Ohio, Western coal imports have never exceeded 2.5 million tons, and were phased out completely in 1983.

The market for Ohio coal has been displaced by lower sulfur eastern coals, particularly those from Eastern Kentucky, which have been available over the past several years at prices comparable to that for Ohio coal. These changes in the utility market account for 80 percent of the decreased demand for Ohio coal, and indicate utilities are the logical focal point for efforts to increase its use once again.

Ohio Coal Characteristics. Nearly 55 billion tons of coal underlie Eastern and Southeastern Ohio (see figure below). Roughly 14 billion tons of this resource is economically producible using present day mining technology.

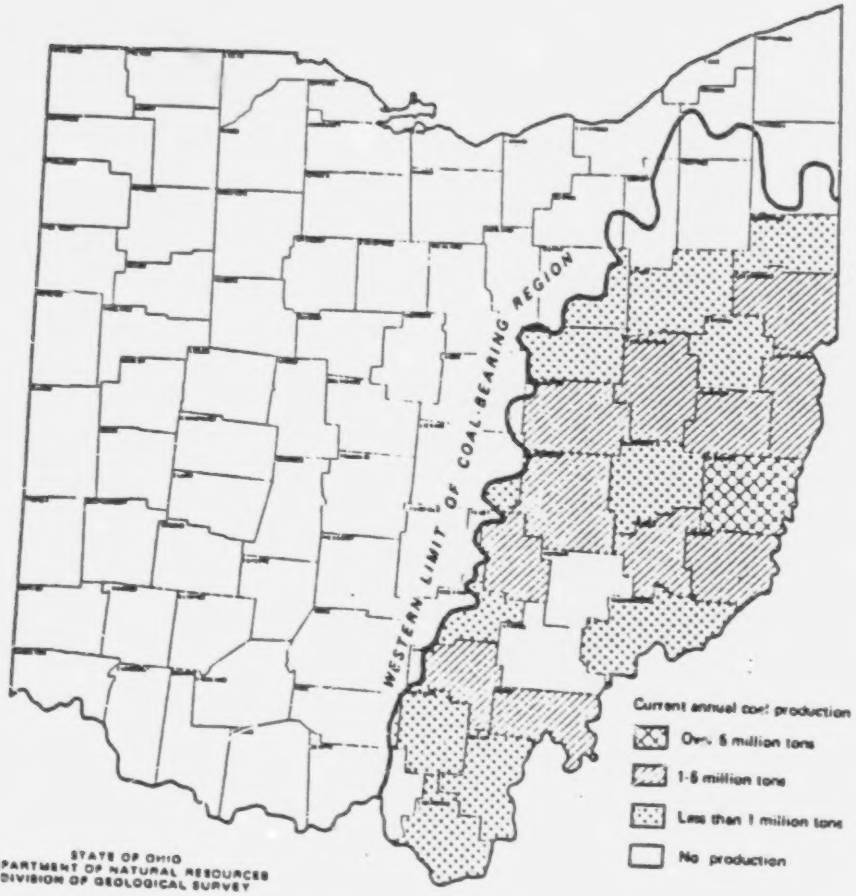
Ohio coal is resident in seams of various physical characteristics, width, and depth. Coal from the same seam may vary widely in its sulfur or ash content. Likewise, in some areas of the state mining from one seam may be done through surface techniques, but elsewhere it is only accessible through deep shafts.

The most commonly mined Ohio coals are the Pittsburgh and Middle Kittanning, and Meigs Creek seams. For many years, roughly two-thirds of Ohio coal has been produced from surface mines, with the remainder from underground mines.

Ohio coal may be described as high Btu bituminous with about 50% fixed carbon, or 11500-12500 Btu per pound. Sulfur content for an Ohio coal usually falls between 2.0 and 6.0%, with the average at about 3.5%. The coal would contain 8-13% ash as it comes from the ground. It would have an ash fusion temperature of 2100-2200 degrees, making it suitable for nearly all boilers. Approximately 60% of Ohio's coal is washed to remove some ash or sulfur, and may be sized to meet specifications for individual purchasers. In all, the physical characteristics, with the exception of sulfur content, of Ohio coal make it a competitive, if not premium, eastern coal. This may be seen in the following table which compares the average characteristics of Ohio coal with averages for other eastern and western coals.

Implications. In general, sulfur content is the only physical characteristic which constrains demand for Ohio coal.

OHIO COAL RESERVES


WESTERN LIMIT OF COAL-BEARING REGION
Current annual coal production
Over 5 million tons
1-5 million tons
Less than 1 million tons
No production

STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY

BEST AVAILABLE COPY

AVERAGE CHARACTERISTICS OF COAL FROM THREE PITTSBURGH NO. 8 LOCATIONS

Ohio County:	Belmont	Harrison	Jefferson
Mining Method:	94% Deep	50% Deep	100% Strip
Characteristics Raw			
Moisture %	3.6	5.4	4.8
Vol Matter %	40.4	38.2	37.2
Fixed Carbon	48.9	50.6	51.9
Ash %	10.5	11.1	10.7
Sulfur %	3.9	3.1	2.9
Btu Content	13140	12950	13130
Ash Temp	2090	2160	2170
Characteristics Washed			
Moisture %	3.4	4.4	3.8
Vol Matter %	41.6	41.0	40.2
Fixed Carbon	49.7	51.5	51.4
Ash %	8.5	7.4	8.3
Sulfur %	3.7	2.5	2.6
Btu Content	13480	13590	13500
Ash Temp	2100	2180	2170

SOURCE: U.S. Coal Production by Seam, 1980.

Average Characteristics of Coal By Producing State, 1982
(As Delivered to Electric Power Plants)

State	Btu/lb.	Sulfur %	Ash %	$/Delivered Ton to Ohio
Ohio	11565	3.3	12.5	38.05
E. Kentucky (low sulfur)	11446	1.1	10.6	42.97
W. Kentucky (high sulfur)	12184	3.2	11.2	33.03
Pennsylvania	12229	1.9	14.1	37.00
West Virginia	12398	1.8	11.5	42.67
Wyoming (lignite)	8686	0.4	6.2	40.66

Production. Ohio coal is produced in 23 counties, from more than 300 mines, by more than 200 production companies, and about 10,000 mining employees. At its peak in 1970, the Ohio coal production industry produced 55 million tons, placing it fifth in the country with about 9% of total production. By 1982, Ohio had fallen to seventh, with 34 million tons of production, and 4.6% of the national total.

Major mining companies, those of over 1 million tons of production across the country, produce about 70% of Ohio's coal. These include Consolidation Coal, Peabody, North American, and subsidiaries of electric utilities, oil companies, and major industries. The remainder of the market is comprised of mostly smaller independent producers with fewer and smaller mines, often operating on a shoestring with limited markets for their product.

Electric utilities own or operate about 25% of Ohio's coal mine production. These captive operations are usually operated by an independent contractor or subsidiary, and have their output dedicated to specific electric generating plants. American Electric Power maintains captive arrangements for both Columbus & Southern Ohio Electric and Ohio Power. Ohio Edison has a similar captive arrangement to supply Ohio coal to its Bruce Mansfield Plant in Pennsylvania. This degree of reliance on captive fuel supply is not a common characteristic of utilities in other eastern states.

Productivity from Ohio coal mines is now increasing after having declined by one half between 1970 and 1980. At current annual productivity rates, it takes about 270 miners to produce one million tons from a surface mine and 500 miners per million tons per year from a deep mine.

Implications. Continued increases in productivity and associated lowering of production costs will enhance the competitive mine-mouth price of Ohio coal.

Price. Ohio coal, particularly that purchased by Ohio utilities, has historically been relatively high in average price despite its high sulfur content. Reasons include Ohio's large mine-mouth proportion of captive utility coal with its higher average price than open market coal, the significant volume of coal from deep mines with its higher production cost, and the influence of labor contract terms. In addition, the proximity of Ohio's mines to their traditional markets have allowed the mine-mouth cost to rise against the transportation cost needed to bring in out-of-state coal.

Average Mine Price of Coal By Producing State
1979-1982
($/ton)

Producing State	1979	1980	1981	1982
Ohio	24.09	27.82	29.11	32.13
Captive	27.85	32.06	34.51	37.79
Open Market	23.22	26.82	27.92	30.78
E. Kentucky (low-sulfur)	27.62	28.73	30.72	30.87
W. Kentucky (high-sulfur)	22.17	24.72	27.66	29.25
Pennsylvania	29.97	30.34	33.18	32.80
West Virginia	34.74	34.88	38.05	37.72
Wyoming (lignite)	9.71	10.54	11.83	12.75
U.S. Average	23.75	24.65	26.40	27.25

Implications. The influence of Ohio coal prices in dampening demand for Ohio coal has commonly been overlooked. The base input fuel cost becomes increasingly important with the expectation of additional coal utilization costs necessitated by sulfur removal requirements. The final cost of using Ohio coal must remain competitive with the final cost of using out-of-state coals.

Changes in the current coal market may improve the competitiveness of Ohio coal. Environmental regulations, and the consequent shift in demand to low-sulfur Eastern coals, have begun to evidence themselves in rising prices for these coals. West Virginia coal, on average, is now selling $10-12 per ton more than Ohio coal of comparable characteristics other than sulfur content. As this disparity increases, the dollar amount which may be economically invested in sulfur removal should increase.

However technologies for sulfur removal must be made available soon for users, particularly utilities, to put together sound, cost effective environmental compliance plans. Utility plans to be developed in the near term will significantly determine the upper and lower bounds of markets for Ohio coal in the remainder of the 1980's and 1990's.

Coal Cleaning Technology. Important characteristics of Ohio's existing utility plants and boilers limit the direction of coal cleaning efforts to retain Ohio coal markets. First, despite an aging stock of utility boilers, no new coal-fired plants are to be built in Ohio within the next ten years, although the Zimmer plant now under construction may be converted to coal. Technology necessary to reduce sulfur emissions, whether before, during, or after combustion, will need to be of a retrofit, rather than replacement nature. Second, there are no "typical" coal-fired utility boilers among Ohio utilities, although individual utilities do have units with similar characteristics. Therefore, the solutions posed for one plant will not necessarily be responsive to the needs of another. Emphasis will need to be placed on the systems or techniques common to most or all Ohio power plants, with additional incremental attention to individual plants in cooperation with the operator utility.

The only flue gas scrubbers in Ohio, those at the Conesville plant of AEP's Columbus and Southern Ohio Electric Company, are operating more efficiently now than when installed five and seven years ago respectively. They also demonstrate that this "best available technology" is a most expensive means of achieving sulfur emissions reductions. Scrubbers may achieve the necessary gross reductions in emissions and permit Ohio coal to be burned. However, compliance with probable federally mandated sulfur reduction levels through scrubbers at major Ohio electric plants will likely cost Ohio electric utilities one billion dollars per year with an additional indirect cost to the Ohio economy of $2-3 billion. There are, however, promising technology alternatives, which can make burning Ohio coal environmentally acceptable at significantly lower cost.

Currently, other promising coal cleaning technologies exist that are cheaper than sulfur oxide stack gas scrubbers, which can be made commercially available to Ohio utilities in time for meeting Ohio sulfur limitation dates in the early 1990's. The promising technologies now being developed which could allow continued burning of Ohio coal within a 1.2 pound sulfur per ton limit are:

- advanced methods cleaning of raw coal to remove component sulfur;
- mixing input coal with reagents to reduce emissions;
- removing sulfur as an integrated part of combustion;
- removing sulfur with particulate emissions;
- treating flue gases to remove sulfur oxides; and, more radically,
- conversion of high sulfur coal to gas or synthetic petroleum fuels; and
- diluting emissions through mixing of coal with gas, oil, or water.

Commercial availability of any one of these technologies will not on its own solve Ohio coal's market problems. For example, intensive coal washing and chemical cleaning will be necessary but insufficient to bring all Ohio utility coals within the 1.2 pound limit. Direct limestone injection into existing utility boilers may be one means of fixing more sulfur in the boiler ash, thus reducing flue gas emissions. Small scale demonstration is underway at an Ohio power plant to find an effective means of combining limestone with flue gas to trap sulfur in existing particulate baghouses. In the longer term, multistage direct limestone injection boilers may be retrofit into some existing power plant units.

Each of these technologies represents a development opportunity with some potential commercial applicability in Ohio while specifically protecting and promoting the continued and future use of Ohio coal.

Implications. Ohio electric utilities are the largest market for Ohio coal, and must therefore be the principal target for any State program to aid the marketing of Ohio coal. This implies that program facilities and projects must reflect utility boiler sizes, operations and constraints. Investments in time and financial resources must be tied to the actual specifications of Ohio utility boilers. For example, according to utility sources, direct limestone injection is only a viable alternative for about 30% of Ohio's utility boilers.

While many Ohio utilities are conducting research on their own facilities, there is no ongoing demonstration program of various utility scale technologies using Ohio coal. It is in the common interest of utilities, producers, and miners to participate in joint projects to promote greater use of Ohio coal. Institutional support from the Public Utility Commission of Ohio, Ohio Water Development Authority, Ohio Air Quality Development Authority, and others might be combined with the research capabilities of Ohio's universities and colleges, and the marketing and development expertise of the Department of Development.

Petroleum Sources

Petroleum fuel products include heating oil, residual fuel oil, diesel fuel, gasoline, propane, kerosene, and jet fuel. Prices and distribution of petroleum products have been deregulated since January 1981. Ohio is served by "prime suppliers" of petroleum products, such as Sohio, Marathon, and Ashland as well as other major national oil companies.

Ohio is also served by several independent oil companies supplied by other national prime suppliers and by some 300 independent petroleum marketers. These independents provide an important middle level distribution role between prime suppliers and many wholesale petroleum product customers, independently operated gasoline stations, and home heating customers. In recent years, Ohio's petroleum marketers have expanded their own retail gasoline station operations. Ohio's branded retail transportation fuel market is lead by Sohio with 24 percent of the 1982 Ohio market of 5.6 million gallons:

Company	% of State Market
Sohio	24.0
Marathon[1]	12.6
Shell	5.0
Ashland[2]	4.4
Sun	4.0

---

[1] Including Bonded, Gastown, Speedway.

[2] Including Savemore.

In addition, Sohio, is a large supplier to wholesale vehicle fleet operators purchasers and of unbranded transportation fuels to other retailers. Together Sohio and Marathon provide nearly half the actual transportation fuels supplied to Ohio. About 25 percent of Ohio's retail service stations are owned, operated and/or supplied by Sohio and Marathon.

Ohio has six petroleum refineries:

Owner	Location	Capacity Bbls/day	
Ashland	Canton	66,000	
Ashland	Findlay	20,400	(currently idle)
Gulf	Cleves	43,700	
Sohio	Lima	161,000	
Sohio	Toledo	120,000	(40,000 currently idle)
Sun	Toledo	118,000	

For the most part, crude oil is received and refined products are shipped to and from these refineries by pipeline. The refining process may be altered to produce somewhat more gasoline or somewhat more distillate fuel (including heating oil). On average, a 42-gallon barrel of crude oil will produce:

Gasoline	18-20	gallons
Distillates (diesel, No. 2 fuel oil)	8-10	" "
Residual Oil (No. 6 fuel oil)	5	" "
Jet Fuel	3	" "
Petrochemical Fuelstocks	2	" "
Waxes, lubricants, asphalt	4-6	" "

Motor fuels are delivered to storage and transfer terminals at various locations throughout the state. Most major oil companies participate in cooperative supply agreements whereby, for example, a Sohio terminal may service all Mobil stations in its area.

Alternative Energy Resources

Alternative energy resources include active and passive solar energy, photovoltaic cells, wind power, hydrothermal systems, and energy from biomass. From a base of zero in 1972, these sources produce an equivalent of about 1.5 percent of the total Ohio 1982 energy consumption.

Annual Renewable Energy Production
(Billion Btu)

	1982	1972
Wood	48,000.0	N/A
Passive Solar	1,993.6	0
Alcohol	590.8	0
Active Solar	498.4	0
Hydrothermal	334.6	0
Photovoltaic	0.1	0
Wind	0.0027	0
	51,417.5	0

Solar Energy. On a small scale or experimental basis, solar energy installations have been installed in this state for over ten years.

A major event was the building in 1974 of the Solar Demonstration Home at the State Fairgrounds. Immediately following that period, Ohio builders, designers and engineers received a succession of awards from numerous federal and private agencies to construct active and passive solar systems. The data reported herein is reconstructed based upon manufacturing records and data from the Internal Revenue Service and does not include commercial or corporate installations.

In 1978, an estimated $22 million of active Ohio solar installations were completed in Ohio. By 1981, this amount had nearly doubled to $43 million. By the end of 1983, we estimate cumulative installation to be about $68 million; by 1985, at $92 million; and 1990, at $128 million. In addition, an unknown number of Ohio households which have qualified solar installations have not applied to the IRS for tax credits. It is extremely difficult to estimate total consumer savings on utility fuels to date due to annual climatic variations, and various efficiency differences among equipment and systems. On the basis of IRS data for active Ohio residential solar systems, we estimate that solar provided 40 billion Btu in 1978 and 317 billion Btu by 1981. By 1983, solar's cumulative impact is estimated at 694 billion Btu, growing to 1359 billion by 1985, and 3924 billion Btu by 1990.

Active solar in Ohio is most often used for solar domestic water heating. On average, the Ohio solar residential customer can achieve a 60 percent energy cost savings on water heating. In the area of active residential space heating, the trend is away from whole house systems to the installation of one or two solar air panels to provide additional heat for one or two rooms.

The largest Ohio active commercial solar installation is a $4 million industrial concentrating collector system at the USS Chemical Plant in Haverhill, Ohio. Using 50,400 square feet of collectors, this system provides industrial process steam to the plant. Annually this plant produces 8 billion Btu of power. The Montgomery Ward installation in Sharonville produces 1.4 billion Btu annually. As the expansion of solar third party power installations and leasing systems continues the relative impact of commercial solar activities could far exceed the impact of residential applications.

Passive Solar. Over the next 20 years passive solar will have a most important impact on residential energy consumption. As the housing stock is replaced or increased, consumers are demanding energy efficient home designs. Most custom home builders are now offering these systems as an option. In addition to the single family residential market, passive has made some preliminary impacts on the design of multifamily and commercial buildings. Conservatively, the potential passive solar energy contribution is at least four times that of active and probably much beyond. Therefore, passive solar energy contributions are estimated to be 2,776 billion Btu for 1983, with a cumulative total by 1990 at 15.7 trillion Btu.

Photovoltaic cells are solar electric cells which change sunlight directly into electricity. The quantity of energy supplied is negligible in Ohio. The only major installation in Ohio is the WBNO-AM radio station in Bryan, Ohio, which receives 90% of its power from the cells. The 15 kw system produces about 1/10 of one billion Btu/year with a cumulative production by 1990 of .1 billion Btu.

Wind Power. Wind-generated energy has made only a negigible impact on Ohio. Wind conditions in the Lake Zone rate good-to-excellent but only moderate elsewhere in Ohio. Ohio has about 160 wind installations, ranging in size from 2 kilowatts to 100 kilowatts (Plum Brook), with an average size of about 6 kilowatts. If we assumed that all installations were in the northern part of Ohio where the wind is strongest, total power production from all would equal only about 2.6 megawatt hours annually. Assuming only residential and small farm or business installation, it is projected that growth will remain small, possibly only doubling in number by 1990, with cumulative power production of 36.7 megawatt hours. A significant change in these estimates would result if wind farm development occurred.

Hydrothermal systems. Hydrothermal systems (ground-water heat pumps) are commonly offered as an option by many Ohio heating and air conditioning firms as a cost-effective alternative to conventional systems. Hydrothermal systems work more efficiently than conventional air-source heat pumps. In the period of 1979-1981, based on IRS claims, the total number of installations amounted to 3,446 with a minimally projected value of over $43 million. Moderate growth is expected with total investment estimated at approximately $56 million by 1983, $66 million by 1985, and $90 million by 1990. In energy units the 3,446 units would annually provide 29.2 billion Btu which should modestly climb to 618 billion Btu by 1990 in annual production or a cumulative effect of 4.8 trillion Btu in the period 1979-1990.

Energy From Biomass. Ohio has plentiful agricultural and forestry resources which can be burned directly or converted into alcohol or other biomass energy products.

1) Wood. According to a survey conducted by Davey Environmental Services, 31 percent of all Ohio households burned some wood during the 1981-82 heating season. Of those households, 21 percent used wood as their principal fuel, while 37 percent used it as a supplemental fuel. According to the survey analysis, total use of wood is estimated at 2 million cords of wood for the 1981-82 heating season or roughly 48 trillion Btu per year. Assuming a 10% growth per year would roughly double annual wood energy usage to 100 trillion Btu by 1990.

2) Alcohol. Wood and agricultural products can both be used to

produce alcohol. The 60 million gallon ethanol alcohol fuel plant at South Point, Ohio, started production in November 1982 and has produced more than 15.5 million gallons through June 1983. Other grain-based smaller alcohol producers represent an additional Ohio ethanol production of about 820,000 gallons annually A 10 million gallon wood-to-alcohol conversion project in Southeastern Ohio could be completed by 1985. Alcohol production will be a slow growth area due to the large capital investment needed. By 1990, annual production is estimated to be no more than 90 million gallons per year.

3) Other Biomass. Other biomass processes are in the experimental stages and presently do not provide a significant proportion of the state's energy supply.

NEAR TERM ISSUES

In this Ohio Energy Status Report, we have examined how Ohio energy consumers, providers, and producers have responded to the changing dynamics of energy, set in motion by the Arab Petroleum Embargo of 1973. In the 1980's, the driving force of Ohio's energy dynamics is price: the continuing high price of energy to consumers, the inability of lower-income consumers to pay, and the effects upon Ohio industry's competitiveness.

Several major near term Ohio energy issues affect Ohio energy consumers, providers, and public agencies as consumers continue responding to energy costs rising faster than their incomes. The common interest of all Ohio sectors is further reduction in energy operating costs.

1) Energy conservation has become Ohio's most cost-effective energy resource. However, capital and loan sources to initiate conservation are limited. In many cases, the cheapest source of the next Btu of energy for an Ohio consumer is energy saved through conservation. Between 1972 and 1982, Ohio's overall energy consumption per dollar of Gross State Product decreased 15 percent. In fact, Ohio industry, the state's largest energy consuming sector, now uses 40 percent less energy for each dollar of output product compared to 1972.

In 1982, Ohioans used less energy than any year since 1965. Although 1982 consumption levels were somewhat tempered by the recession, over 200 trillion Btu's of avoided energy costs are clearly attributable to rigorous energy usage efficiency improvements in all consuming sectors. For example, Ohio residential consumers used over 20 percent less heating fuel than in 1972. However, after such conservation, the average Ohio household still paid nearly four times more in 1982 for home heating than in 1972. While the 200 trillion Btu savings in 1982 represents an avoided cost to Ohio consumers of over $1 billion, the portion of their personal and business income needed to pay for energy is still much higher than in 1972.

Most low cost/quick payback conservation initiatives have been undertaken. Due to Ohio's relatively old and energy inefficient housing, building, and industrial plant stock, further cost effective conservation improvements will require substantial capital investment. Therefore, new sources of capital, loan guarantees, and low interest loans are needed by lower income and small business consumers to undertake conservation measures and to purchase more efficient equipment.

2) Rising energy prices have resulted in the availability of a wider variety of energy products and services. Ohio consumers who have the financial ability can now purchase solar and geothermal heating for their homes, contract for lower-priced Ohio self-help gas for their schools and factories, generate their own electric power, and sell any excess power generated to an electric utility. They can contract to have building energy control systems and equipment

installed at no capital cost to themselves through "shared savings" agreements with local energy management companies. In order to cut costs and to assure more control over future fuel supplies, industrial users in particular have investigated multiple fuel use systems, waste steam recovery, and direct purchase of natural gas.

Providers will continue to offer a growing variety of full and customized services. These services include customized fuel blends, weatherization audits and installations, and specialized financial arrangements. These and other services will increase Ohio consumers' ability to select those providers which can provide both the level of service and the product of their choice. In that way, Ohio consumers will be able to gain greater control over their energy costs while fulfilling their requirements.

3) Public/private cooperative programs are now being used to finance, market, and deliver Ohio energy products and services. A joint public-private Energy Action Corporation established in 1983 will offer subsidized interest loans for energy conservation to lower- and moderate-income consumers who normally would not qualify for loans. The Corporation is directed by a Board representing financial institutions, utilities, and service providers, as well as state and local government representatives.

The Department of Development has also pursued innovative financing in cooperation with state and private agencies for projects which develop and market Ohio energy resources. These arrangements could include loan guarantees, low-interest financing, formation of small producer cooperatives, and product purchase guarantees.

Such innovative public-private approaches can also help commercialize new, emerging energy technologies and products in areas like coal cleaning.

4) Increasing public accountability by Ohio gas and electric utilities will continue to keep consumers' utility costs down and maintain Ohio's industrial competitiveness. One way to do this is through more extensive use of management audits which examine utility management practices to see how well they provide adequate and reliable service to consumers at the least cost. Important issues will include the source, price, reliability and flexibility of present and future fuel supplies. Utility plans for new facilities should also be examined rigorously to be sure that proper need assessments, timing, project management and review, and cost control practices are adhered to. Management audits have already been undertaken for Columbia Gas of Ohio on gas purchasing practices and for the Zimmer generating plant on costs possibly due to mismanagement.

Natural gas will continue to be the predominant fuel for Ohio heating uses. Recently, the high cost of interstate pipeline gas and the availability of less expensive Ohio-produced gas has generated a renewed and greater interest in direct purchase of Ohio gas. Many Ohio industries, gas distribution utilities, universities, school systems, and industrial development parks now wish to use Ohio self-help gas to stabilize or reduce their natural gas costs. However, significant increases in use of self-help gas will be dependent upon opening access to the more than 4000 miles of gas utility transmission lines within Ohio.

The PUCO has granted more rate hikes for gas utility companies recently than the Federal Energy Regulatory Commission (FERC) has, for a variety of reasons, including the present gas glut, recession, etc. While the bulk of gas increases have been due to FERC's active role in allowing higher prices or changing other Federal policies, we must continue to give close attention to that portion of Ohio gas rates controlled by PUCO.

A second means of increasing public accountability is through extensive review of and public hearings on the long-range plans of utilities for future plant and fuel needs. Continued over-forecasting of consumer electric demand throughout the 1970's resulted in excessive planned construction of new power plant facilities. The recent cancellation of four planned nuclear and three coal-fired generating plants has affected consumer rates, as well as our electric utilities' capital structure and bond ratings. As coal will continue to provide over 95 percent of Ohioans' electricity, the sources of Ohio electric utilities' coal supplies and their costs are very important. The huge costs of future Ohio electric utility compliance with clean air requirements will also be felt in utility bills.

In 1983, Ohio's gas and electric utilities became subject to public review of their long-range consumer demand forecasts and the reasonableness of their planning for future capital construction and fuel supplies. Opening utility long-range planning to public participation and scrutiny will assure that Ohio's utilities consider a variety of cost effective alternatives to new facility construction and high-cost fuel supplies. This public review process of long-term Ohio utility fuel source and facility planning is conducted by the Ohio Department of Development.

The Ohio Public Utilities Commission has recently determined that Ohio's energy utilities must provide a wide range of residential conservation services, including efficiency audits, weatherization loans, installation of conservation materials, and monitoring of energy costs avoided. The public hearings on utility long-term planning will help the Commission make least-cost decisions on utility rates, tariffs, fuel supply adequacy, new facility investments, and customer services.

5) Federal legislation and regulations provide much of the context within which Ohio energy producers, utilities, regulators and consumers operate. Though decontrolled prices for new natural gas were deemed necessary by Congress in 1978 to stimulate exploration for and development of new gas supplies, today there is an oversupply of natural gas for the foreseeable future. Serious concern exists nationally whether wellhead gas prices should now be decontrolled at the end of 1984. Although wellhead gas price increases have moderated somewhat recently, all Ohio consuming sectors have already experienced

threefold natural gas price increases since the Natural Gas Policy Act (NGPA) was passed by Congress in 1978.

It is clearly not in the best interest of Ohio to allow "old gas" to be decontrolled, as that would allow higher prices to be charged with no increase in new production. The Celeste Administration supported the successful Congressional effort to block "old gas" decontrol in 1983. In addition, the Celeste Administration supports the Natural Gas Consumer Relief Act which would lower gas prices to January 1982 levels, extend price controls for two years, and require that pipelines purchase the least-cost gas supplies available. (Under current law, prices are allowed to rise each month and most gas is scheduled to be decontrolled on January 1, 1985).

Current legislation also before Congress to require interstate gas transmission pipelines to contract for transporting user-owned gas will help large Ohio gas users, including schools and hospitals, and Ohio distribution utilities to shop for now available lower-priced supplies. Such legislation would benefit all gas customers, including residential consumers.

6) Ohio's own production of energy has been a premier economic growth sector; however markets are now constrained. Ohio's extensive energy resource base of coal, natural gas, and biomass can contribute far more of the energy we will need in Ohio at competitive market prices. Already, Ohio energy production contributes 36 percent of all energy consumed in Ohio and about the same portion of GSP as tires, rubber, and petrochemicals combined.

Ohio coal currently remains demand-constrained due to uncertainties surrounding federal clean air requirements. Expedited development of commercially available clean coal technology is essential to maintenance and expansion of markets for Ohio coal. Focus must be placed on clean coal usage in electric utility markets. Ohio's natural gas is now transportation-constrained. The over 4000 miles of gas pipeline delivery capability within Ohio must be made more available to move Ohio gas from the wellhead to consumer markets.

Even with the current constraints, the dollar value of Ohio energy production has increased almost sevenfold since 1972. By working to overcome the constraints which presently exist, significant benefits to the state can be achieved, leading to additional jobs and access to more reasonably-priced energy sources for Ohioans.

Next Steps. Examination of where Ohio has been in energy over the past 10 years and appears to be going will greatly assist both public and private sector leaders in setting their respective policies and programs for energy in the 1980's. Energy can become a support to a growing, high employment Ohio economy.

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TABLE A-1. RATIO OF U.S. AND OHIO ENERGY USE TO GROSS NATIONAL AND GROSS STATE PRODUCT, 1973-1982 (BTU PER 1972 DOLLARS)

	U.S.			Ohio		
	GNP (Billion Constant Dollars)[a]	Energy Consumption (10^{15} Btu)	Energy Consumption per GNP dollar	GSP (Billion Constant Dollars)[b]	Energy Consumption (10^{12} Btu)[d]	Energy Consumption per GSP dollar
1973	1.255	74.609	59,449	64.075	3935.1	61,414
1974	1.248	72.759	58,300	62.717	3914.7	62,418
1975	1.234	70.707	57,299	59.978	3837.5	63,982
1976	1.300	74.510	57,315	63.658	3960.6	62,217
1977	1.372	76.332	55,636	67.125	3931.4	58,568
1978	1.437	78.175	54,402	69.949	3911.3	55,916
1979	1.483	78.910	53,210	70.781	3969.5	56,081
1980	1.481	75.988	51,309	66,968	3676.0	54,892
1981	1.510	73.984	48,996	66.861	3523.9	52,705
1982	1.485	70.842	47,705	63.919[c]	3323.6[c]	51,997[c]

SOURCES: U.S. Department of Commerce, Statistical Abstract of the United States 1980, Table 796. U.S. Department of Commerce, Survey of Current Business, April 1982, Table 7.1-7.2, p. 16 U.S.DOE, Monthly Energy Review, June 1983.

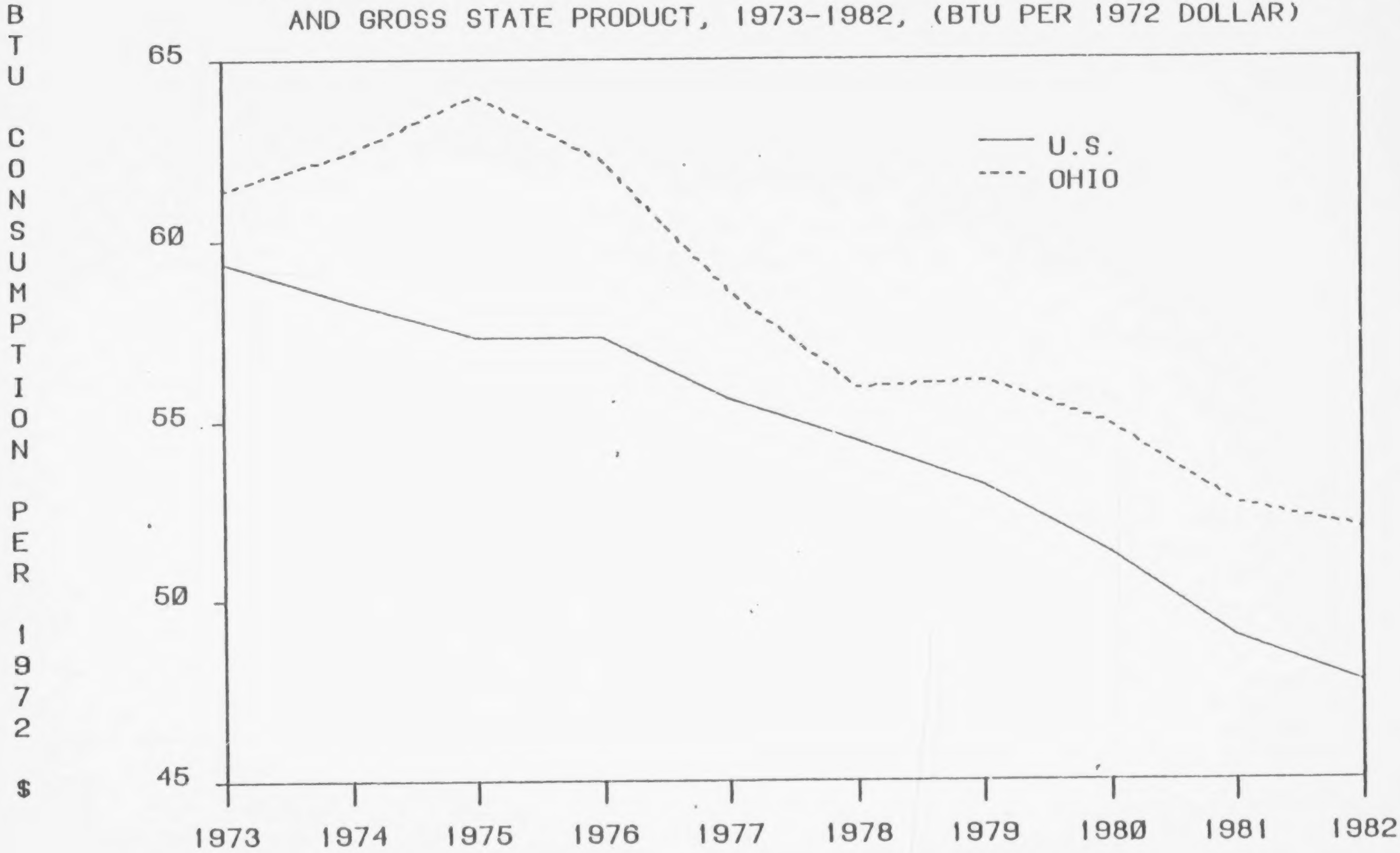
[a] Constant Dollars (1972 = 100) based on implicit price deflators.

[b] Gross State Product figures (1973-1979) supplied by the Ohio Department of Development, Office of Research.

[c] Estimates calculated by the Ohio Division of Energy. Gross State Product estimate is based on the adjusted percentage decline in the reported U.S. GNP for 1981-1982.

[d] Computed by the Ohio Division of Energy.

FIGURE A-1. RATIO OF U.S. AND OHIO ENERGY USE TO GROSS NATIONAL AND GROSS STATE PRODUCT, 1973-1982, (BTU PER 1972 DOLLAR)



SOURCES: U.S. DEPARTMENT OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES 1980, TABLE 796. U.S. DEPARTMENT OF COMMERCE SURVEY OF CURRENT BUSINESS, APRIL 1982, TABLE 7.1-7.2, P. 16, U.S. DOE, MONTHLY ENERGY REVIEW, JUNE 1983.

TABLE A-2: PER CAPITA ENERGY CONSUMPTION, OHIO AND U.S., 1972-1982, (MILLION BTU)

	Ohio[a]	U.S.[b]
1972	369.2	NA
1973	365.5	354.6
1974	363.6	343.4
1975	356.3	331.0
1976	368.3	346.2
1977	365.0	351.9
1978	362.3	357.8
1979	367.6	357.7
1980	340.4[c]	335.1
1981	326.7[d]	322.3
1982	308.0[c]	306.0[d]

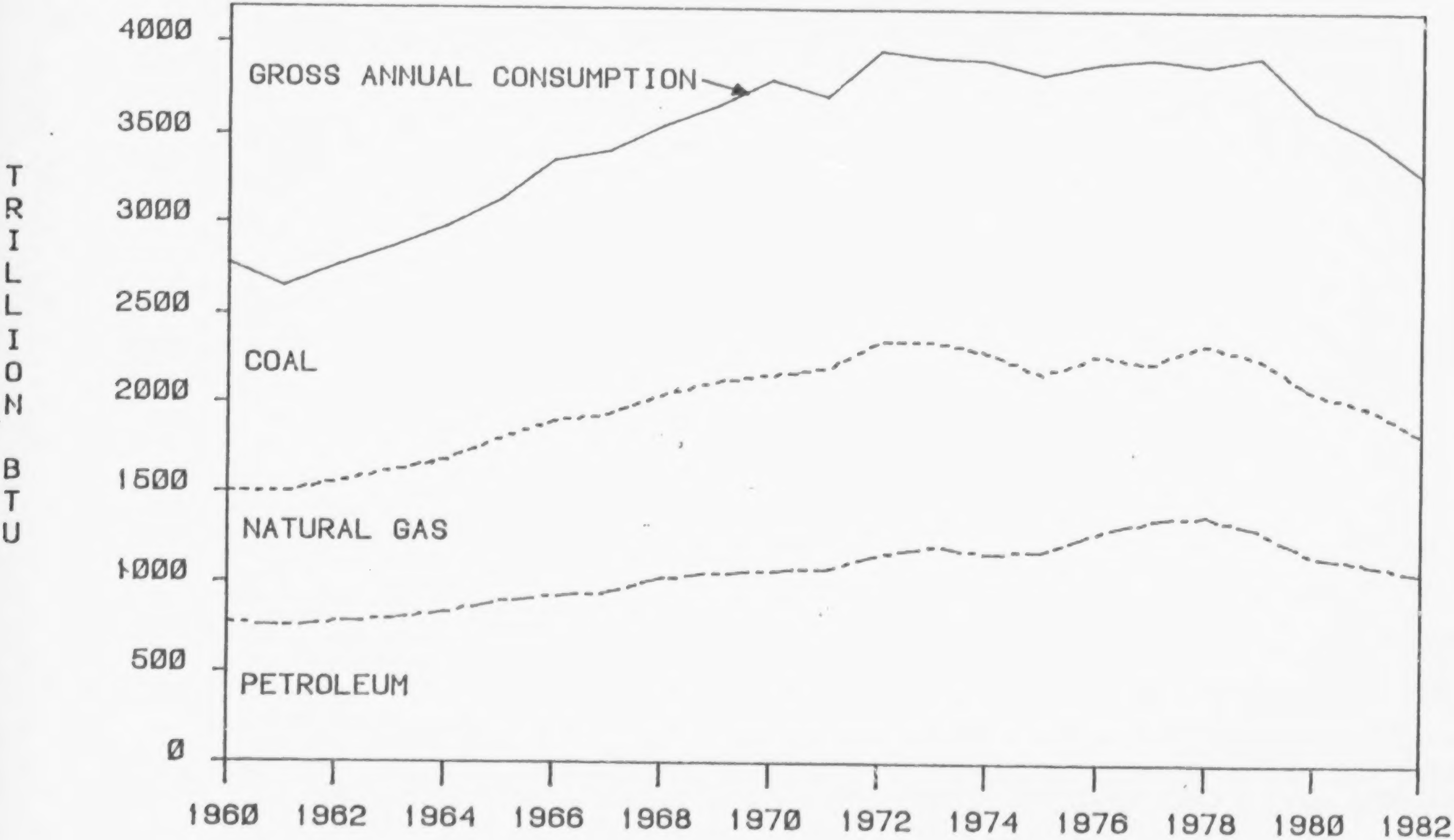
[a] Ohio population data 1971-1979 published in U.S. Bureau of Census, "Inter-Censal Population Estimates," February 1, 1982. Ohio energy consumption totals computed by the Ohio Division of Energy.

[b] U.S. data published in U.S. Department of Commerce, Statistical Abstract of the United States 1980. U.S. energy consumption data published in USDOE, Monthly Energy Review, June 1983.

[c] Based on a provisional estimate of state population by the U.S. Bureau of Census.

[d] Based on population figures from the Population Division of the U.S. Bureau of Census, July 26, 1983.

FIGURE B-1.1. OHIO GROSS ENERGY CONSUMPTION BY FUEL, TRILLION BTU, 1960 - 1982



SOURCE: OHIO DIVISION OF ENERGY

Consumption of nuclear and hydroelectric energy, which comprises less than 1.5 percent of total consumption from 1972-1982 has been deleted from graph.

TABLE B-1.1. OHIO GROSS ENERGY CONSUMPTION BY FUEL, TRILLION BTU, 1972-1982

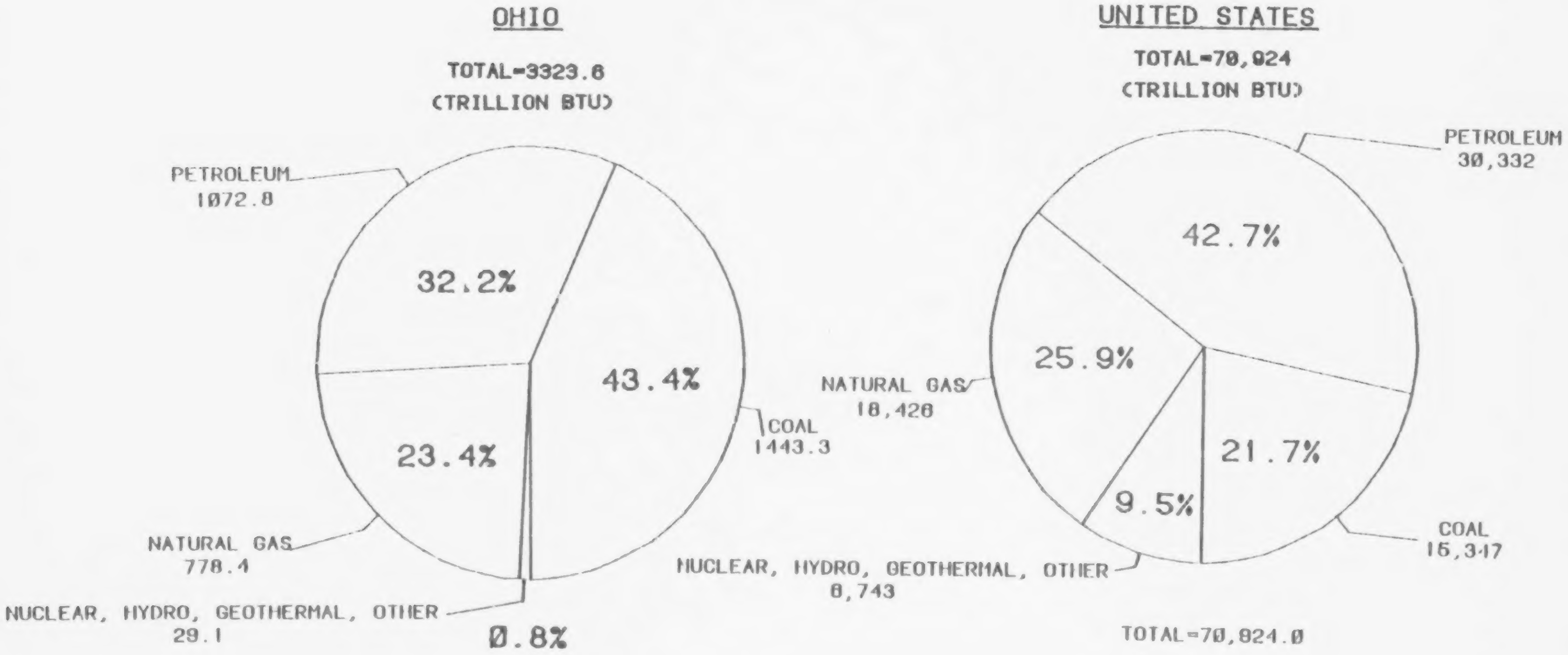
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982(e)
Coal[a]											
Million Short Tons	67.9	65.7	69.7	68.1	71.0	74.2	68.0	72.8	67.3	64.1	62.2
Trillion Btu	1,620.3	1,581.9	1,620.8	1.659.0	1,632.5	1,691.4	1,543.4	1,677.2	1,576.2	1,501.7	1,443.3
% of Total	40,8%	40.2%	41.4%	43.2%	41.2%	43.0%	39.5%	42.0%	42.6%	42.3%	43.4%
Petroleum[a]											
Million Barrels	218.4	228.0	220.23	223.7	242.3	255.6	260.3	231.7	213.7	201.9	195.2
Trillion Btu	1,162.6	1,213.6	1,172.4	1,190.8	1,296.9	1,368.5	1,384.8	1,322.7	1,195.2	1,135.2	1,072.8
% of Total	29.3%	30.8%	29.9%	31.0%	32.6%	34.6%	35.4%	33.1%	32.3%	32.0%	32.3%
Natural Gas[a]											
Billion Cu.Ft.	1,147.8	1,104.2	1,086.6	956.9	957.4	859.3	930.3	936.2	880.2	844.8	754.3
Trillion Btu	1,184.5	1,139.5	1,121.4	987.5	988.0	886.8	960.1	966.2	908.4	871.8	778.4
% of Total	29.9%	29.0%	28.6%	25.7%	26.2%	22.4%	24.6%	24.2%	24.6%	24.6%	23.4%
Nuclear & Hydro											
Billion kWh	0.0	0.0	0.0	0.0	0.0	5	2.4	3.2	2.1	4.4	3.2
Trillion Btu	0.1	0.1	0.1	0.1	0.1	4.6	22.6	28.5	19.1	39.7	29.1
% of Total	0%	0%	0%	0%	0%	0.1%	0.6%	0.7%	0.5%	1.1%	0.9%
Total Gross Energy											
Trillion Btu	3,967.5	3,935.1	3,914.7	3,837.4	3,917.5	3,951.3	3,910.9	3,994.6	3,698.9	3,548.4	3,323.6

SOURCE: The Ohio Division of Energy and the Federal Energy Data Systems (FEDS).

Estimates (e) prepared by the Ohio Division of Energy.

[a] Total fuel consumption includes the electric utilities sector, comprised of private, public, municipal, and rural-cooperative electric utilities.

FIGURE B-1.2. GROSS ENERGY CONSUMPTION BY FUEL, 1982, OHIO AND U.S.



SOURCES: U.S. DEPARTMENT OF ENERGY, MONTHLY ENERGY REVIEW, APRIL 1983, AND THE OHIO DIVISION OF ENERGY.

TABLE B-1.2. OHIO GROSS ENERGY PRODUCTION AND DOLLAR VALUE BY FUEL, 1970 - 1982

Year	Crude Oil (000's Bbls.)	Dollar Value[a] (000's $)	Natural Gas (MMCF)	Dollar Value[a] (000's $)	Coal[d] (000's Short Tons)	Dollar Value[e] (000's $)	Total Value (000's $)
1970	9,864	32,194.0	73,759	20,533.5	55,137	261,349.4	314,798.9
1971	9,670	29,800.0	82,678	27,290.5	49,017	256,849.1	313,939.6
1972	9,358	35,179.4	90,487	35,271.3	50,572	301,409.1	371,859.8
1973	8,796	44,690.0	94,121	39,785.9	45,666	337,928.4	422,404.3
1974	9,088	88,992.9	94,376	44,641.8	45,352	558,736.6	692,371.3
1975	9,578	113,916.5	85,810	60,604.2	46,673	765,437.2	939,957.9
1976	9,994	117,654.9	89,770	90,511.6	46,804	779,673.4	987,839.9
1977	10,359	136,280.9	99,656	139,267.3	46,940	830,838.0	1,106,386.2
1978	11,154	154,043.1	115,239	181,843.7	38,840	846,323.6	1,182,260.4
1979	11,953	269,129.1	124,665	222,824.1	43,528	1,048,589.5	1,540,542.7
1980	12,928	468,315.9	138,856	269,102.3	40,951	1,139,256.8	1,876,675.0
1981	13,551	489,048.9	141,134[b]	302,398.5	37,342	1,087,025.6	1,890,173.0
1982	14,571	450,505.3	138,391[c]	370,116.6	38,883	1,249,310.7	2,069,932.6

SOURCES: Ohio Department of Natural Resources, Division of Oil and Gas, Summary of Ohio Oil and Gas Developments in 1982, and Ohio Department of Natural Resources, Division of Geological Survey.

[a] Current dollar value estimates provided by the Department of Natural Resources, Division of Oil and Gas. Prices are wellhead averages for crude oil and natural gas.

[b] Natural gas production in 1981 includes an estimated 2,055 MMCF utilized in the field. Prior to 1981, this volume was not included.

[c] Natural gas production in 1982 includes an estimated 2,015 MMCF utilized in the field.

[d] Ohio Department of Natural Resources, Division of Geological Survey. Includes reject material.

[e] Dollar value estimates based on coal prices reported on U.S. DOE Form EIA-7A, minemouth prices.

TABLE B-1.3. OHIO PROVEN RESERVE ESTIMATES BY FUEL, 1972-1982

Year	Crude Oil (1000 Bbls.)		Natural Gas (MMcf)	Coal[c] (Million Short Tons)
	EIA[a]	API[b]		
1972		127,385	715,151	20,680
1973		124,911	808,641	19,956
1974		123,871	960,662	21,077
1975		121,263	969,020	20,395
1976		125,268	1,025,950	19,230
1977	74,000	129,148	1,093,150	19,157
1978	69,000	131,194	1,711,511	19,090
1979	82,000	137,718	1,313,333	19,035
1980	116,000	136,524	1,436,629	18,978
1981	112,000	NA	1,689,745	18,941
1982	NA	NA	1,730,691	18,826

SOURCES: State of Ohio, Division of Mines Report, 1980. U.S. Department of Interior, Bureau of Mines, Mineral Yearbook. (Coal Data 1970-1974). U.S. DOE Energy Information Administration; Demonstrated Reserve Base of Coal in the U.S. (1976-present). Ohio Department of Natural Resources, Summary of Ohio Oil and Gas Developments in 1982.

[a] U.S. DOE Energy Information Administration Estimates.

[b] American Petroleum Institute Estimates.

[c] ODOE Estimates (based on Ohio production figures).

TABLE B-2.1: OHIO GROSS ENERGY CONSUMPTION BY SECTOR (TRILLIONS OF BTU)

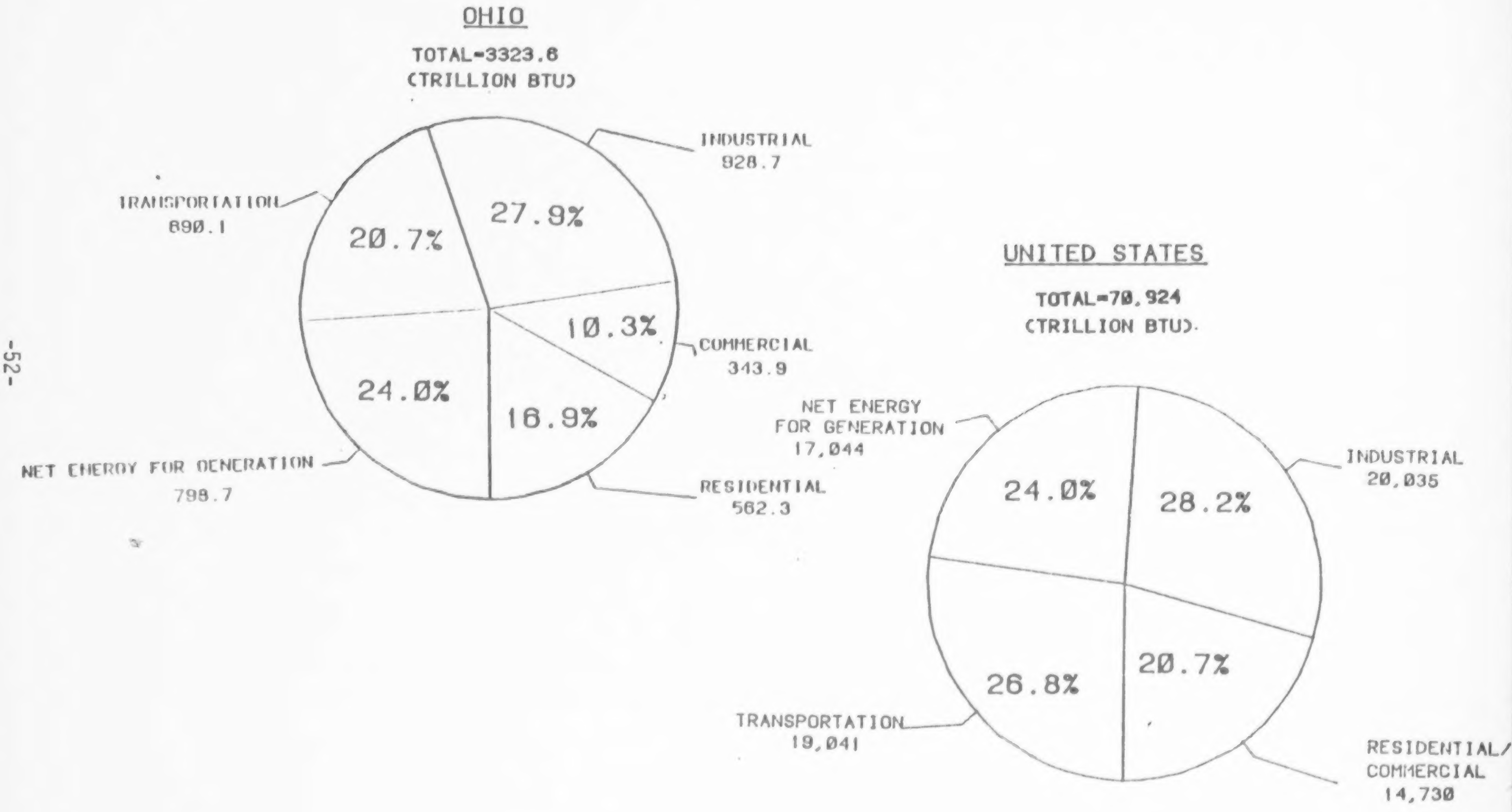
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982(e)
Residential	697.1	662.4	657.2	649.8	678.7	662.7	669.4	643.1	603.6	590.7	562.2
% of Total	17.6%	16.8%	16.8%	16.9%	17.4%	16.8%	17.1%	16.1%	16.3%	16.7%	17.0%
Commercial	396.4	400.4	385.0	374.2	389.9	387.9	400.4	388.4	370.7	353.1	343.9
% of Total	10.0%	10.2%	9.8%	9.8%	10.0%	9.8%	10.2%	9.7%	10.0%	10.0%	10.3%
Industrial	1,470.4	1,478.3	1,483.7	1,293.4	1,324.8	1,334.7	1,306.2	1,351.8	1,186.8	1,171.4	928.7
% of Total	37.1%	37.6%	37.9%	33.7%	33.8%	33.8%	33.4%	33.8%	32.1%	33.1%	28.0%
Transportation	743.3	778.0	734.2	748.5	787.1	805.3	826.3	795.4	743.9	723.7	690.1
% of Total	18.7%	19.8%	18.8%	19.5%	20.1%	20.4%	21.1%	19.9%	20.1%	20.4%	20.8%
Energy for Net Generation Utilities[a]	660.3	616.0	654.6	771.5	737.0	760.7	708.6	815.9	793.9	709.5	798.7
% of Total	16.6%	15.7%	16.7%	20.1%	18.8%	19.2%	18.1%	20.4%	21.4%	20.0%	24.0%
Total Consumption	3,967.5	3,935.1	3,914.7	3,837.4	3,917.5	3,951.3	3,910.9	3,994.6	3,698.9	3,548.4	3,323.6

SOURCES: The Ohio Division of Energy and the Federal Energy Data Systems (FEDS).

(e) Estimates prepared by the Ohio Division of Energy.

[a] Energy for net generation is the difference between the total energy input to electric utilities and the sales of electricity to end-users as listed on ODOE Form SE-1.

FIGURE B-2.1. OHIO GROSS ENERGY CONSUMPTION BY SECTOR, OHIO AND U.S., 1982



SOURCES: U.S. DEPARTMENT OF ENERGY, MONTHLY ENERGY REVIEW, APRIL 1983, AND THE OHIO DIVISION OF ENERGY.

TABLE B-2.2: GROSS ENERGY CONSUMPTION BY FUEL, BY END USE SECTOR, AND PETROLEUM CONSUMPTION BY PRODUCT, 1982, OHIO AND U.S.

B-2.2a. Gross Energy Consumption by Fuel, 1982, Ohio and U.S.

	Ohio		U.S.		Comparative Figures[c]	
	TBtu	% of Total	TBtu	% of Total	% of U.S.	State Rank
Coal	1,443.3	43.4%	15,423.0	21.7%	9.4%	1
Petroleum	1,072.8(e)	32.3%	30,332.0	42.8%	3.5%	7
Natural Gas	778.4	23.4%	18,426.0	26.0%	4.2%	5
Nuclear, Hydro, Geothermal, Other	29.1	0.8	6,743.0	9.5%	0.4%	26
Total[a]	3,323.6(e)	Total	70,924.0	Total	4.7%	3

B-2.2b. Gross Energy Consumption by End-Use Sector, 1982, Ohio and U.S.

	Ohio		U.S.		Comparative Figures	
	TBtu	% of Total	TBtu	% of Total	% of U.S.	State Rank
Residential	562.2(e)	16.9%				
Commercial	343.9(e)	10.3%	14,730.0	20.8% (combined)	8.9%	5
Industrial	928.7(e)	27.9%	20,035.0	28.2%	5.3%	3
Transportation	690.1(e)	20.8%	19,041.0	26.8%	3.6%	6
Energy for Net Generation	798.7(e)	24.0%	17,044.0	24.0%	3.3%	6
Total[a]	3,323.6(e)	Total	70,044.0	Total	4.7%	3

B-2.2c. Petroleum Consumption by Product, 1982, Ohio and U.S.

	Ohio		U.S.[b]		Comparative Figures	
	TBtu	% or Total	TBtu	% of Total	% of U.S.	State Rank
Gasoline	564.4(e)	52.6%	12,523.0	41.3%	4.5%	5
Jet Fuel	32.8(e)	3.1%	2,012.1	6.6%	1.6%	18
Distillate, Diesel, Kerosene	235.8(e)	22.0%	5,955.3	19.6%	4.0%	8
Residual	23.4(e)	2.2%	5,954.0	12.8%	0.6%	22
Other Petroleum Products (LPG, Asphalt)	216.4(e)	20.2%	4,959.4	19.6%	4.4%	3
Total[a]	1,072.8(e)	Total	30,332.0	Total	3.7%	3

SOURCES: U.S. DOE, Monthly Energy Review, April 1983. U.S. DOE, Monthly Petroleum Statement, December 1981. U.S. DOE, State Energy Data Report, June 1983, and the Ohio Division of Energy.

[a] Totals do not add up due to independent rounding.

[b] U.S. totals are based on disposition of petroleum fuels.

[c] "% of U.S." based on 1982 figures. "State Rank" based on 1981 figures.

(e) Estimates prepared by the Ohio Division of Energy.

TABLE B-2.3. PROJECTED SECTORAL ENERGY CONSUMPTION IN OHIO, 1983 - 1993

Sectors	Actual 1982 TBtu	Estimated 1983 TBtu	Predicted Changes in Sectoral Energy Consumption TBtu/Year			Lower 95% Confidence Limit	1993 Forecast TBtu	Upper 95% Confidence Limit
			1984	1985	1986-1993			
Residential	562.2	537.5	-12	-10	+ 8	553.5	579.5	505.5
Commercial	344.0	326.5	- 8	0	+ 2	316.5	334.5	352.5
Industrial	920.4	830.0	+50	+25	+ 7	925.0	961.0	997.0
Transportation	690.2	685.0	+10	+10	+10	747.0	785.0	823.0
Energy Losses of Electric Utilities	798.5	775.0	-50	+50	+10	813.0	855.0	897.0
Total All Sectors	3315.3[a]	3154.0[a]	-10	+75	+37	3355.0	3515.0	3675.0

SOURCE: The Ohio Division of Energy and the Federal Data System (FEDS).

[a] Inconsistent with other tables due to a variation in accounting for petroleum products.

PROJECTED SECTORAL ENERGY CONSUMPTION IN OHIO, 1993
(Table B-2.3)

Methodology and Assumptions

The forecasts, as presented in Tables B-2.3 and B-2.4, are based upon analyses of time variant linear trends in the sectoral energy consumption of the State between 1960 and 1982. The methodology for this type of analysis has been developed in-house by the Ohio Department of Energy to deal specifically with the problems involved in the forecasting and assessment of economic data series.

Significant alterations in economic conditions such as OPEC price hikes, severe devaluation of the dollar, and periods of significant unemployment historically have produced corresponding alterations in the position, magnitude, or direction of prevailing trends.

It should be clear that no meaningful forecasts can be made without including consideration of the political-economic conditions which might prevail over the forecasting horizon. But it should be equally clear that these types of events cannot be explicitly predicted with any degree of reliability. Thus we must devise a proxy to satisfy the requirement to include these external conditions. One major influence that each significant event tends to have is on the State's unemployment rate. For that reason we have based the forecast presented in Table 24 upon the following scenario of average unemployment rate in the civilian labor force:

Presumed Average Rate of Unemployment of the Civilian Labor Force in Ohio--

Year	Rate
1984	9 - 11%
1985	7 - 9%
1986-93	5 - 7%

Our presumptions concerning the level of unemployment are in turn based upon a scenario that the current recession will have bottomed-out for Ohio by 1984 and a sustained recovery will ensue from 1986 on. Such a scenario of a belated recovery is based upon our belief that the structural changes required in Ohio's aging industrial base to make it competitive again nationally and internationally will minimally require the kind of time frame we have stipulated above. We have presumed that no major international incident will occur during the forecasting horizon. However, we have included the 95 percent confidence intervals of the forecast which should practically cover most cases except a very major incident that could disrupt energy consumption patterns in Ohio and the U.S. It should be clear that if significant deviations from the scenario outlined above are realized during the forecasting horizon, the scenario, as well as the forecasts, would have to be adjusted and updated to take such alterations into account.

Conclusion

Most likely estimates of sectoral energy consumption, given our assumptions, indicate that energy consumption in most sectors of Ohio for 1991 will fall somewhere between their respective levels in 1980 and 1982. We also predict that energy consumption in all sectors will continue to decline through 1983, level out and turn upward between 1984 and 1985, and increase along sustainable trends between 1986 and 1993.

If actual trends follow or fall below our estimates, we are confident there will be sufficient energy supplies to sustain the needs of Ohio sectoral end users in 1991. It would also be realistic to expect at least one moderate recession between 1986 and 1993, simply on the basis of the fact that six of the preceding 13 years between 1970 and 1982 have been recessionary periods.

TABLE B-2.4. PROJECTED CONSUMPTION OF PRIMARY FUELS AND ELECTRICITY IN OHIO, 1983 - 1993

Fuels	Actual 1982 (TBtu)	Estimated 1983 (TBtu)	Predicted Change in Energy Consumption by Fuel Type (TBtu/Year)			Lower 95% Confidence Limit	1993 Forecast (TBtu)	Upper 95% Confidence Limit
			1984	1985	1986-1993			
Coal	1443.3	1369.0	-35	+80	+18	1516.0	1558.0	1600.0
Petro. Products	1064.5	1060.0	+20	+20	+10	1098.0	1180.0	1262.0
Natural Gas	778.4	700.0	-10	-10	+ 9	720.0	752.0	784.0
Nuclear & Hydro	29.1	25.0	+15	-15	0	21.0	25.0	29.0
Total All Primary Fuels[a]	3315.3	3154.0	-10	+75	+37	3355.0	3515.0	3675.0
Electricity[b]	358.3	354.0	+14	+14	+ 5	406.0	430.0	454.0

SOURCE: The Ohio Division of Energy and the Federal Data Systems (FEDS).

[a] 1982 total is inconsistent with other tables due to a variation in accounting for petroleum products.

[b] As electricity is a derived fuel, primary fuel inputs required to generate electricity are already included in the primary fuel totals above.

ENERGY CONSUMPTION OF PRIMARY FUELS AND ELECTRICITY IN OHIO
(Table B-2.4)

Methodology and Assumptions

The general methodology and assumptions mentioned for Table B-2.3 also apply to the breakdown of total energy requirements in terms of primary fuel types and electricity. Since electriciy is derived from transformation of fossil fuels, from nuclear energy, or hydro generation it is treated separately to avoid double counting.

The forecasts presented in Table B-2.4 foresee a moderate coal strike in 1984 as reflected in alteration in coal consumption levels in 1984 and 1985.

Conclusion

Available data and analysis indicate that we shall experience another steep decine in natural gas consumption levels across all sectors in 1983; a slight upturn may be expected from 1986 on.

The decline in petroleum products' consumption has bottomed out in 1983, and we can expect a steady increase in petroleum consumption as the economy pulls out of the current recession.

Coal consumption may display some discrete jumps in 1984 and 1985 due to the possible coal strike and as production resumes in some of the idle steel plants in the state. However, we do not expect steel production levels to reach the 1977 highs during our current forecasting horizon of 1983-1993. Similarly, we expect the rate of growth in sectoral electricity sales to be considerably less after the current recession relative to the rates of growth experienced before the 1977-1980 period. Both of these factors should account for a modest but steady growth in coal consumption levels except during strike years.

If any of the nuclear generation units currently under construction were to be brought on-line within the forecasting horizon, this event would primariy have an impact on the projected consumption of coal.

TABLE C-1. OHIO GROSS ENERGY CONSUMPTION BY FUEL, RESIDENTIAL SECTOR, 1974-1982

	1974		1975		1976		1977		1978		1979		1980		1981		1982(e)	
	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu
Distillate/Kerosene[a] (MM Bbls)	13.37	77.4	13.79	79.8	17.70	102.4	17.67	102.2	17.36	100.5	16.37	94.9	12.35	71.7	10.86	73.1	10.21	59.1
% of Total		11.8%		12.3%		15.1%		15.4%		15.0%		14.8%		11.9%		12.4%		10.5%
LPG (MM Bbls)[a]	4.90	20.0	5.16	20.7	5.31	21.3	5.00	20.1	4.87	19.5	3.37	13.5	2.53	10.2	2.78	11.2	2.61	10.5
% of Total		3.0%		3.2%		3.1%		3.0%		2.9%		2.1%		1.7%		1.9%		1.9%
Petroleum Total	18.35	97.4	18.95	100.5	23.01	123.7	22.67	122.3	22.21	120.0	19.74	108.4	14.88	81.9	13.64	84.2	12.82	69.6
% of Total		14.8%		15.5%		18.2%		18.4%		17.9%		16.9%		13.6%		14.2%		12.4%
Coal (MM Tons)	0.76	18.8	0.50	12.2	0.46	11.2	0.40	9.7	0.26	6.2	0.36	4.8	0.26	8.5	0.46	10.7	0.47	10.9
% of Total		2.9%		1.9%		1.6%		1.5%		0.9%		0.7%		1.4%		1.8%		1.9%
Natural Gas (Billion Cu. Ft.)	435.8	449.8	427.81	441.5	431.20	445.0	411.63	424.8	421.42	424.9	406.0	419.0	385.46	397.8	369.86	381.8	356.49	367.9
% of Total		68.5%		67.9%		65.6%		64.1%		65.0%		65.2%		65.9%		64.6%		65.4%
Electric (Billion kWh)	26.72	91.2	28.02	95.6	28.95	98.8	31.03	105.9	31.75	108.3	32.50	110.9	33.75	115.45	33.42	114.0	33.35	113.8
% of Total		13.9%		14.7%		14.4%		16.0%		16.2%		17.2%		19.1%		19.3%		20.2%
Total		657.2		649.8		678.7		662.7		669.4		643.1		603.6		590.7		562.2

SOURCES: The Ohio Division of Energy and the Federal Energy Data System (FEDS)

[a] Liquified Petroleum Gases include ethane ethylene, propane, propylene, butane, butylene, butane-propane mixtures, ethane-propane mixtures and isobutane

Estimates (e) prepared by the Ohio Division of Energy

TABLE C-2. OHIO GROSS ENERGY CONSUMPTION BY FUEL, COMMERCIAL SECTOR, 1974-1982

	1974		1975		1976		1977		1978		1979		1980		1981		1982 (e)	
	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu
Asphalt (MM Bbls.)[a]	9.26	61.5	9.03	59.9	8.13	53.9	10.15	67.3	10.85	72.0	10.55	70.0	9.09	60.3	7.62	50.6	7.65	50.7
% of Total		16.0%		16.0%		13.8%		17.3%		18.0%		18.0%		16.3%		14.3%		14.7%
Distillate (MM Bbls.)	4.71	27.4	4.98	29.0	6.23	36.3	6.20	36.1	6.29	36.6	6.44	37.5	4.95	28.8	4.29	25.0	3.75	21.8
% of Total		7.1%		7.8%		9.3%				9.2%		9.6%		7.8%		7.1%		6.3%
Gasoline (MM Bbls.)	0.83	4.3	1.13	6.0	1.07	5.6	0.91	4.8	0.93	4.9	1.10	5.8	2.20	11.6	1.43	7.5	10.7	5.6
% of Total		1.1%		1.6%		1.4%		1.2%		1.2%		1.5%		3.1%		2.1%		1.6%
LPG (MM Bbls.)	0.55	2.2	0.57	2.3	0.59	2.4	0.56	2.2	0.54	2.2	0.38	1.5	0.45	1.8	0.49	2.0	0.46	1.8
% of Total		0.6%		0.6%		0.6%		0.6%		0.5%		0.4%		0.5%		0.6%		0.5%
Residual (MM Bbls.)	1.23	7.7	3.06	19.2	3.45	21.7	3.61	22.7	3.36	21.1	1.35	8.5	0.38	2.4	0.50	3.1	0.19	1.2
% of Total		2.		5.1%		5.6%		6.1%		5.3%		2.2%		0.6%		0.9%		0.3%
Petroleum Total	16.58	103.1	16.77	116.4	19.47	119.9	21.43	133.1	21.97	136.8	16.44	123.3	16.90	104.9	14.33	88.2	13.12	81.1
% of Total		26.8%		31.1%		30.7%		35.5%		34.2%		31.7%		28.3%		25.0%		23.6%
Coal (Million Tons)	0.41	10.2	0.27	5.6	0.25	6.1	0.22	5.3	0.14	3.4	0.10	2.4	0.19	4.5	0.25	5.8	[illegible]	5.9
% of Total		2.6%		1.8%		1.6%		1.4%		0.8%		0.6%		1.3%		1.6%		1.7%
Natural Gas (Billion Cu. Ft.)	192.5	198.7	169.38	174.8	179.39	185.1	161.63	166.8	172.48	178.0	171.90	177.4	167.54	172.9	163.12	168.3	[illegible]	164.3
% of Total		51.6%		46.7%		47.4%		43.0%		44.5%		45.7%		46.6%		47.7%		47.8%
Electric (Billion kWh)	21.39	73.0	22.38	76.4	23.10	78.8	24.24	82.7	25.00	82.2	25.0	85.3	25.88	88.4	26.63	90.8	27.13	92.6
% of Total		19.0%		20.4%		20.2%		21.3%		20.5%		22.0%		23.0%		25.8%		26.9%
Total		385.0		374.2		389.9		387.9		400.4		388.4		370.7		353.1		343.9

SOURCE: The Ohio Division of Energy and the Federal Data System (FEDS).

[a] According to U.S. Department of Energy methodology, total asphalt consumption is allocated to the commercial sector.

Estimates (e) prepared by the Ohio Division of Energy.

TABLE C-3. OHIO GROSS ENERGY CONSUMPTION BY FUEL, INDUSTRIAL SECTOR, 1974-1982

	1974		1975		1976		1977		1978		1979		1980		1981		1982(e)	
	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu
Diesel Fuel (MM Bbls.) % of Total	1.68	9.8 0.7%	2.04	11.9 0.9%	2.80	16.3 1.2%	2.29	13.3 1.0%	2.54	14.8 1.1%	3.58	20.8 1.5%	3.35	19.5 1.6%	2.44	14.2 1.2%	3.18	18.5 2.0%
Distillate/Kerosene (MM Bbls.) % of Total	6.24	40.2 2.7%	5.89	37.8 2.9%	7.48	46.5 3.5%	9.39	58.2 4.4%	8.51	52.6 4.0%	8.27	48.1 3.6%	7.50	43.8 3.7%	6.99	38.6 3.3%	6.32	36.8 4.0%
Gasoline (MM Bbls.) % of Total	1.55	8.1 0.5%	1.35	7.1 0.5%	1.22	6.4 0.4%	1.12	5.9 0.4%	1.03	5.4 0.4%	0.91	4.8 0.4%	1.12	3.9 0.5%	0.95	5.0 0.4%	0.76	4.0 0.4%
LPG (MM Bbls.) % of Total	1.80	7.2 0.5%	1.63	6.6 0.5%	1.87	7.5 0.6%	2.28	9.2 0.7%	3.25	13.1 1.0%	4.88	19.5 1.4%	4.50	18.1 1.5%	4.40	17.6 1.5%	4.13	16.6 1.8%
Residual (MM Bbls.) % of Total	4.32	27.2 1.8%	5.67	32.6 2.5%	6.41	40.3 3.0%	6.52	53.6 4.0%	7.50	47.2 3.6%	6.63	41.7 3.1%	5.68	35.7 3.0%	4.50	28.3 2.4%	2.60	16.4 1.8%
Other Petro. Products[a] (MM Bbls.) % of Total	21.97	120.9 8.2%	20.39	115.8 9.0%	20.80	133.7 10.1%	23.83	139.6 10.5%	24.64	135.5 10.4%	24.79	142.8 10.6%	24.02	138.6 11.7%	24.35	137.7 11.8%	23.41	136.3 14.7%
Petroleum Total % of Total	37.57	213.4 14.4%	36.97	211.1 16.3%	40.58	250.7 18.9%	47.43	279.8 21.0%	47.47	268.6 20.6%	46.06	277.7 20.5%	44.12	261.6 22.0%	39.38	241.4 20.6%	39.96	228.6 24.6%
Coal (Million Tons) % of Total	24.36	632.6 42.6%	20.88	542.2 41.9%	20.16	522.4 39.4%	21.21	548.4 41.0%	18.73	484.4 37.1%	19.10	496.9 36.8%	16.12	415.5 35.0%	16.87	432.7 36.9%	12.11	309.8 33.3%
Natural Gas (Billion c.f.) % of Total	427.62	441.3 29.7%	344.57	355.6 27.5%	333.92	344.6 26.0%	274.61	283.4 21.2%	324.42	334.8 25.6%	343.90	354.9 26.2%	314.53	324.6 27.4%	301.74	311.4 26.6%	231.14	238.5 25.7%
Electric (Billion kWh) % of Total	57.56	196.4 13.2%	54.07	184.5 14.3%	60.71	207.1 15.6%	65.38	223.1 16.7%	64.02	218.4 16.7%	65.14	222.3 16.4%	59.92	185.1 15.6%	54.49	185.9 15.9%	44.49	151.8 16.3%
Total		1,483.7		1,293.4		1,324.8		1,334.7		1,306.2		1,351.8		1,186.8		1,171.4		928.7

SOURCES: The Ohio Division of Energy and the Federal Energy Data Systems(FEDS).

[a] Includes petroleum coking coal and petrochemical feedstocks.

Estimates (e) prepared by the Ohio Division of Energy.

TABLE C-4. OHIO GROSS ENERGY CONSUMPTION BY FUEL, TRANSPORTATION SECTOR, 1974-1982

	1974		1975		1976		1977		1978		1979		1980		1981		1982(e)	
	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu	Physical Units	Trillion Btu
Distillate/Diesel (MM Bls.) % of Total	14.91	86.8 11.8%	15.26	88.9 11.9%	17.96	104.6 13.3%	17.04	99.3 12.3%	19.45	113.3 13.7%	17.06	99.4 12.5%	16.35	95.2 12.8%	17.46	101.7 14.1%	17.28	94.8 13.7%
Gasoline (MM Bbls.) % of Total	114.99	603.4 82.2%	116.96	613.8 82.0%	121.37	637.0 80.9%	125.73	659.8 81.9%	127.29	668.0 80.8%	122.40	656.1 82.5%	112.38	602.4 80.9%	110.75	581.2 80.3%	105.71	554.8 80.4%
Jet Fuel (MM Bbls.) % of Total	5.65	31.1 4.2%	5.95	32.3 4.3%	5.66	31.3 4.0%	6.06	33.5 4.2%	5.62	31.2 3.8%	4.72	26.2 3.4%	5.48	36.0 4.8%	5.43	30.1 4.2%	5.94	32.8 4.8%
LPG (MM Bbls.) % of Total	0.09	0.4 -0-	0.07	0.3 -0-	0.08	0.3 -0-	0.09	0.3 -0-	0.08	0.3 -0-	0.07	0.3 -0-	0.06	0.2 -0-	0.08	0.3 -0-	0.08	0.3 -0-
Residual (MM Bbls) % of Total	0.33	2.1 0.3%	0.61	3.8 0.5%	0.93	5.8 0.7%	0.64	4.0 0.5%	0.65	4.1 0.5%	0.72	4.5 0.6%	0.26	1.6 0.2%	0.30	1.9 0.3%	0.27	1.7 0.2%
Petroleum Total % of Total	135.97	723.8 98.6%	138.85	739.1 98.7%	146.0	779.0 99.0%	153.09	796.9 99.0%	153.09	816.9 98.9%	144.97	786.5 98.9%	135.53	735.4 98.9%	134.02	715.2 98.8%	129.28	684.4 99.2%
Natural Gas (Billion c.f.) % of Total	10.02	10.3 1.4%	9.03	9.3 1.2%	7.72	8.0 1.0%	8.06	8.3 1.0%	8.97	9.2 1.1%	8.39	8.7 1.1%	8.00	8.3 1.1%	8.00	8.3 1.1%	5.41	5.6 0.8%
Electric (Billion kWh) % of Total	0.04	0.1 -0-	0.04	0.1 -0-	0.04	0.1 -0-	0.04	0.1 0.1%	0.05	0.2 -0-	0.05	0.2 -0-	0.05	0.2 -0-	0.05	0.2 -0-	0.04	0.1 -0-
Total		734.2		748.5		787.1		805.3		826.3		795.4		743.9		723.7		690.1

SOURCES: The Ohio Division of Energy and the Federal Energy Data System(FEDS).

Estimates (e) prepared by the Ohio Division of Energy.

TABLE C-5. OHIO ELECTRIC UTILITY ENERGY ACCOUNT, 1978-1982

	1979			1980			1981			1982		
	Physical Units	TBtu[a]	Percent of Total[b]	Physical Units	TBtu[a]	Percent of Total[b]	Physical Units	TBtu[a]	Percent of Total[b]	Physical Units	TBtu[a]	Percent of Total[b]
Deliveries[c,e]												
Coal (tons)	52,804,500	1,123.7	98.0	49,523,400	1,055.4	98.8	44,314,200	944.9	99.4	44,867,500	946.3	99.5
Oil (barrels)	3,372,800	21.0	1.8	1,612,400	10.0	0.9	644,900	4.0	0.4	799,800	5.0	0.5
Natural Gas (MCF)	2,051,100	2.1	0.2	3,235,400	3.3	0.3	1,299,400	1.3	0.1	641,500	0.1	0.0
Consumption[d]												
Coal (tons)	51,493,046	1,100.9	97.2	47,917,401	1,020.6	98.3	47,589,702	1,013.7	99.2	45,034,323	949.8	99.4
Oil (barrels)	4,470,256	27.9	2.5	2,170,160	13.6	1.3	1,036,044	6.5	0.6	866,148	5.4	0.6
Natural Gas (MCF)	4,169,184	4.3	0.4	3,750,299	3.9	0.4	1,360,497	1.4	0.1	721,720	0.1	0.0
Generation (MWH)												
Coal	110,952,383	378.6	95.8	106,209,896	36.24	97.3	105,747,220	360.8	95.9	100,886,854	344.2	96.7
Oil	1,645,722	5.6	1.4	701,757	2.4	0.6	167,614	0.1	0.0	108,423	0.1	0.0
Natural Gas	102,252	0.3	0.1	168,491	0.6	0.2	69,361	0.2	0.1	22,791	0.2	0.1
Nuclear	3,163,138	10.8	2.7	2,119,116	7.2	1.9	4,406,819	15.0	4.0	3,225,076	11.0	3.1

SOURCE: Federal Power Commission Forms 4 and 423, and the Ohio Division of Energy.

[a] Conversion from physical units to TBtu based on "Conversion Factors" published in U.S. DOE, Monthly Energy Review, June 1983.

[b] Percent totals may not add to 100 due to independent rounding.

[c] Form 423, utility fuel deliveries, provides totals for the Ohio portion of privately owned plants with 25 MW generation capacity or greater.

[d] Form 4, generation and consumption of fuels, provides totals for the Ohio energy portion of privately owned plants.

[e] Historical delivery totals for coal and oil as published in previous Status Reports have been revised, based on updated reports from utilities.

TABLE C-6. CURRENT AND PROJECTED FUEL MIX FOR ELECTRIC GENERATING CAPACITY, OHIO SERVICE PORTION, 1982, 1987, AND 1992 (MEGAWATTS)

	1982[a]	1987[b]	1992[b]
Coal	32,572	34,733	35,259
Oil and Gas	1,862	1,543	1,526
Nuclear	1,596	4,393	5,598
Hydro, Pumped Storage	305	369	369
Cogeneration	240	240	240
Total	36,575	41,278	42,992

SOURCES: Ohio Electric Utilities' 1983 Ten-Year Forecasts, Forms FE-6 and FE-7 (c).

[a] Actual demonstrated capability.

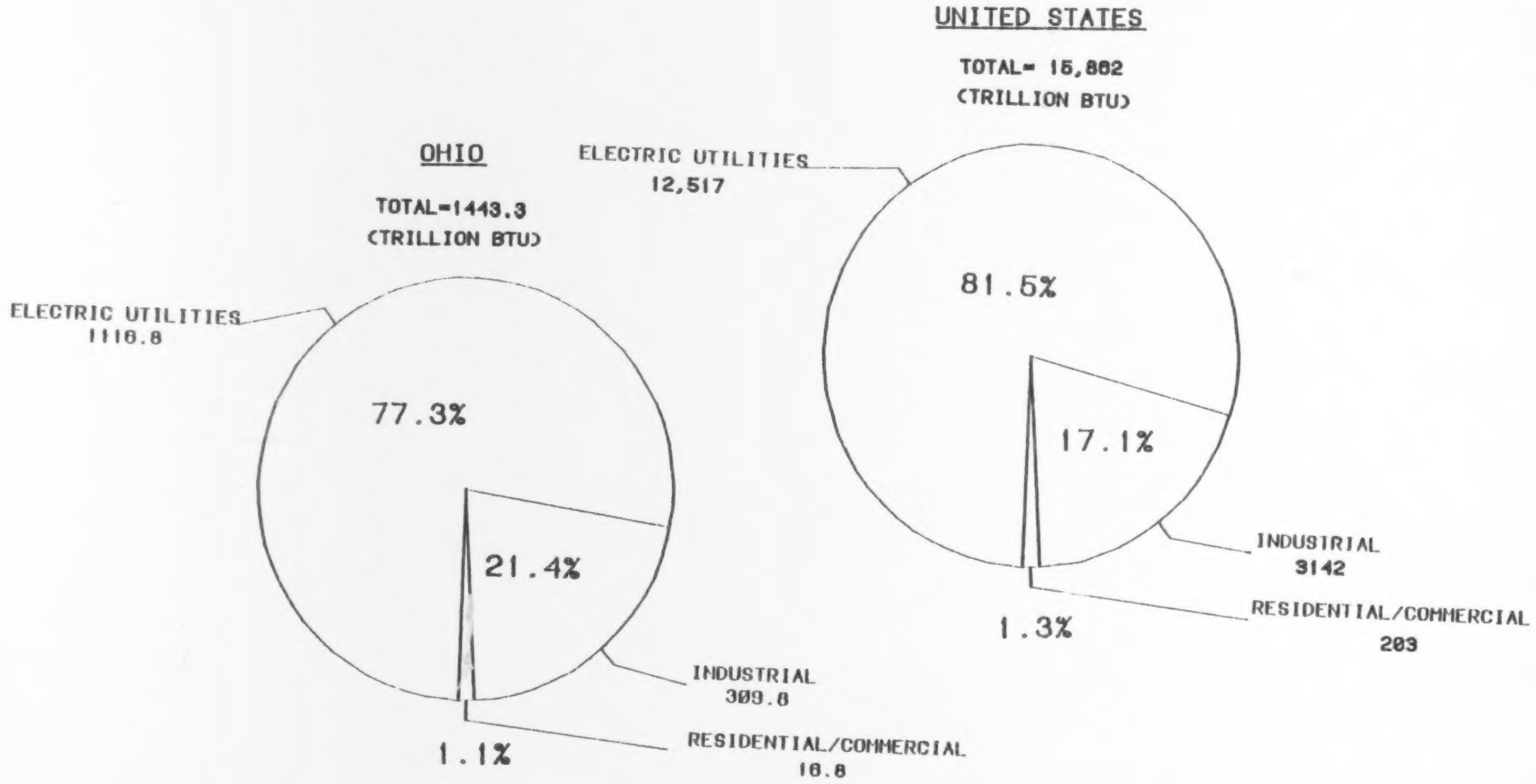
[b] Ohio future share of capacities of plants serving in and out-of-state consumers is estimated as the proportion of system net energy for load that is in-state in 1987 and 1992. Figures include upratings and retirements.

TABLE C-7. OHIO ELECTRIC UTILITY DISPOSITION OF ELECTRICITY, 1981, 1982 (MEGAWATT-HOURS)

	Net Energy for Load		Net Ohio Generation		Energy Bought (Sold) From (To) Out-of-State or Other Utilities	
	1982	1981	1982	1981	1982	1981
Buckeye Power	4,285,998	3,548,861	7,679,833	7,523,149	(3,393,835)	(3,924,835)
Cincinnati Gas and Electric	13,443,308	13,663,858	12,959,052	13,755,267	484,256	(91,409)
Cleveland Electric Illuminating	17,677,831	18,938,963	17,032,759	15,061,031	645,072	3,877,932
Columbus and Southern Electric	9,789,251	9,773,150	10,547,275	11,342,229	(758,024)	(1,569,079)
Dayton Power and Light	10,712,454	10,986,544	9,928,113	10,055,782	784,341	930,762
Monongahela Power	562,573	597,779	0	0	562,573	597,779
Ohio Edison	19,011,798	20,470,559	14,047,958	16,130,740	4,963,840	4,339,819
Ohio Power	23,362,001	28,757,604	20,679,356	26,650,592	2,682,645	2,107,012
Ohio Valley Electric Corporation	7,024,717	7,018,132	7,038,341	6,903,882	(13,624)	114,250
Toledo Edison	7,341,542	7,594,608	7,331,528	7,437,533	10,014	157,075
Total	113,211,473	121,400,058	107,244,215	114,861,205	5,967,258	6,539,853

SOURCES: Forms FE-1(A) and (D) of the Ohio Electric Utility 1983 Ten Year Forecasts.

FIGURE D-1.1. COAL CONSUMPTION BY SECTOR, 1982, OHIO AND U.S.



SOURCES: U.S. DEPARTMENT OF ENERGY, *MONTHLY ENERGY REVIEW*, APRIL 1983, AND THE OHIO DIVISION OF ENERGY.

TABLE D-1.1. SURFACE AND UNDERGROUND PRODUCTION OF OHIO COAL, 1973-1982 (THOUSAND TONS)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982[b]
Underground Production	16,209.4	14,415.5	15,469.3	16,707.6	14,004.2	11,389.2	14,546.0	14,573.0	12,100.3	14,019.3
Surface Production	29,457.1	30,936.1	31,203.6	30,096.3	32,936.0	28,705.0	28,982.0	26,378.0	25,241.7	24,863.3
Total Production[a]	45,666.5	45,351.6	46,672.8	46,803.9	46,940.1	40,094.2	43,528.0	40,951.0	37,342.0	38,882.6

SOURCE: Ohio Department of Natural Resources, Division of Geological Survey.

[a] Total production is the sum of underground and surface production, plus coal reject material.

[b] Preliminary data from Ohio Department of Natural Resources, Division of Geological Survey.

TABLE D-1.2: OHIO COAL USE BY SOURCE, 1970-1982 (THOUSAND SHORT TONS)

Year	Western[a] Coal	Eastern[b] Coal	Total Imports	Ohio Coal	Ohio Exports	Total Use[c]
1970	-0-	31,822	31,822	35,553	19,584	67,375
1971	-0-	29,513	29,513	33,603	15,414	63,116
1972	-0-	32,665	32,665	35,130	15,422	67,795
1973	-0-	32,348	32,348	33,409	12,257	65,557
1974	1,172	35,426	36,598	33,044	12,308	69,642
1975	1,433	33,118	34,551	33,468	13,205	68,019
1976	3,372	32,191	35,563	35,401	11,403	70,904
1977	4,841	33,051	37,892	36,240	10,700	74,132
1978	4,700	32,504	37,204	30,707	8,133	67,912
1979	3,835	36,908	40,745	32,059	11,619	72,804
1980	2,484	35,357	37,841	29,360	9,923	67,201
1981	2,811	32,925	35,736	28,400	9,139	64,136
1982	1,829	33,367	35,196	27,003	8,580	62,199

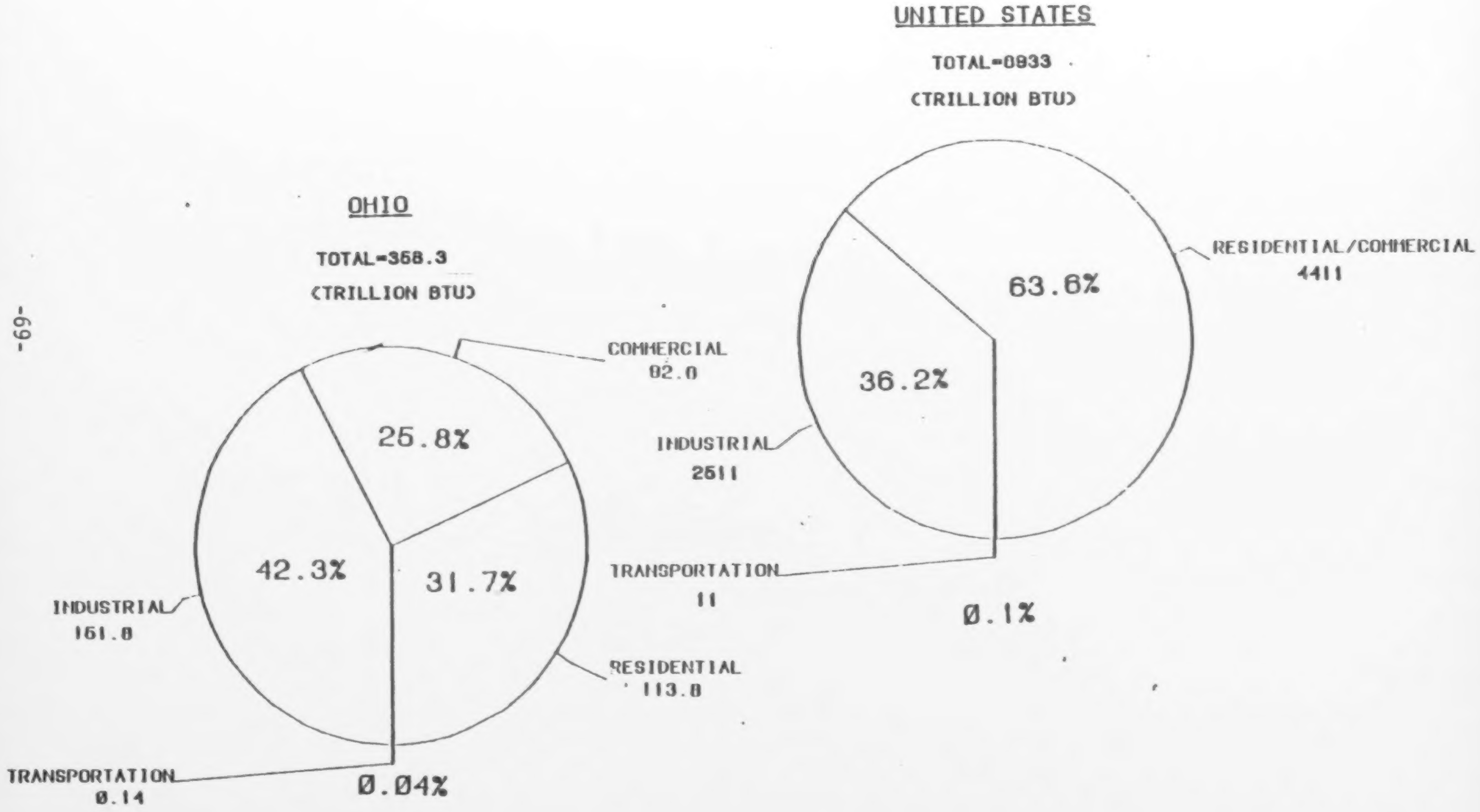
SOURCES: U.S. DOE Energy Information Administration, Coal Distribution (formerly Bituminous Coal and Lignite Distribution), DOE/EIA-0125 (82), Tables 8 and 9.

[a] Western Region includes Idaho and Wyoming.

[b] Eastern Region includes Maryland, Pennsylvania, West Virginia, Virginia, Kentucky, North Carolina, Tennessee, Illinois, Indiana, Alabama and Georgia.

[c] Totals may not equal the sum of components due to independent rounding.

FIGURE D-2.1. ELECTRICITY CONSUMPTION BY SECTOR, 1982, OHIO AND U.S.



SOURCES: U.S. DEPARTMENT OF ENERGY, MONTHLY ENERGY REVIEW, APRIL 1983, AND THE OHIO DIVISION OF ENERGY.

TABLE D-2.1. CURRENT AND CONSTANT PRICES OF ELECTRICITY IN OHIO BY SECTOR, 1970 - 1983 (CENTS PER KWH)

	Current Dollars			Constant Dollars[a]		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial
1970	2.27	2.04	0.93	2.45	2.21	1.01
1971	2.33	2.14	1.00	2.42	2.22	1.04
1972	2.38	2.19	1.01	2.38	2.19	1.01
1973	2.43	2.24	1.05	2.30	2.12	1.00
1974	2.91	2.73	1.45	2.49	2.34	1.24
1975	3.41	3.19	1.78	2.70	2.52	1.41
1976	3.56	3.31	1.78	2.68	2.49	1.34
1977	4.01	3.82	2.04	2.86	2.72	1.45
1978	4.38	4.18	2.40	2.92	2.79	1.60
1979	4.74	4.53	2.63	2.90	2.77	1.61
1980	5.13	4.97	3.12	2.86	2.77	1.74
1981[b]	5.95	5.71	3.92	3.06	2.94	2.02
1982[b]	6.75	6.45	4.76	3.29	3.14	2.32
1983[c]	7.43	6.89	4.93	3.49	3.24	2.32

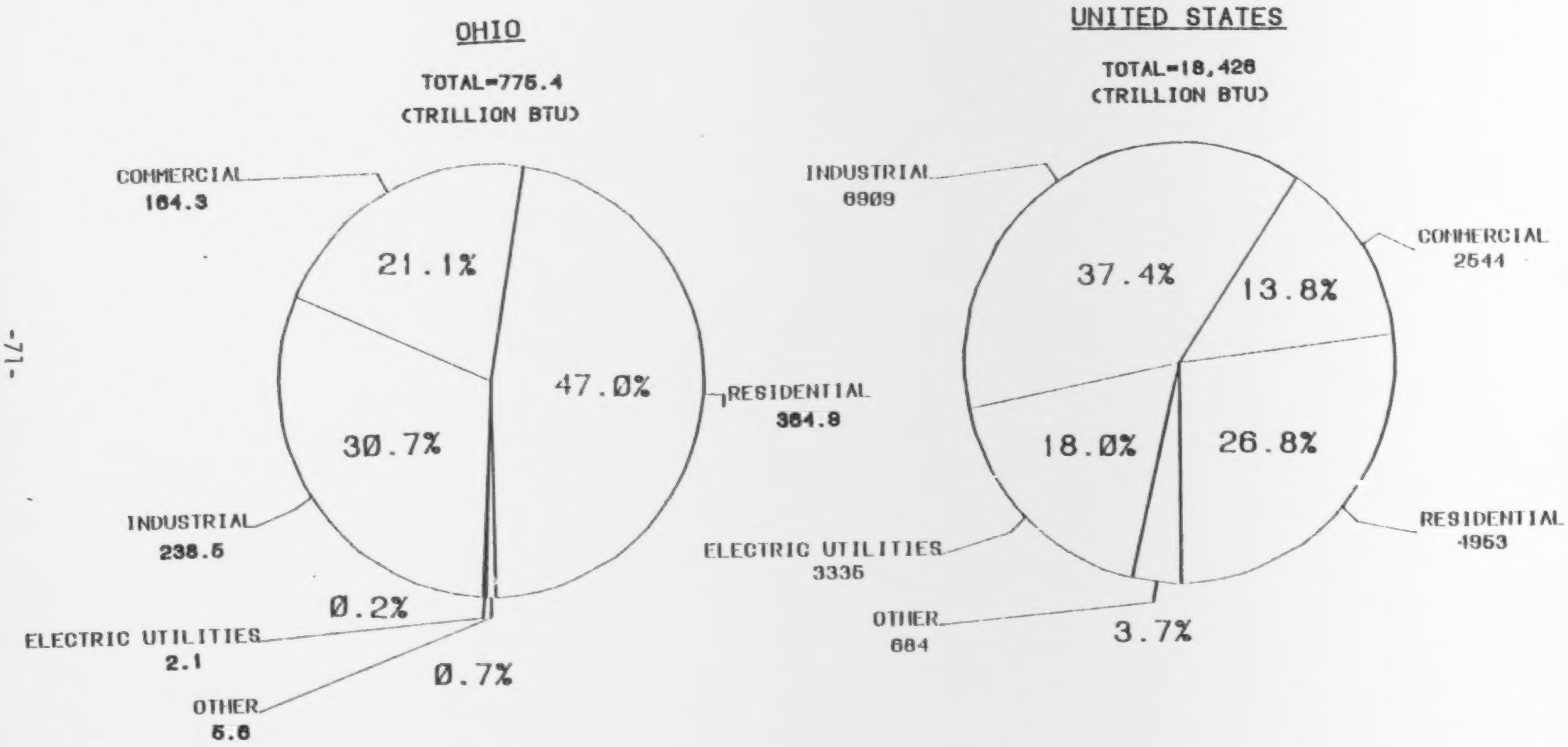
SOURCE: US D.O.E., Energy Information Administration, State Energy Price System, Overview and Technical Documentation, November, 1982, Volume 1, and the Ohio Division of Energy, Form SE-1.

[a] Constant dollars are derived from current dollars using US Bureau of Commerce implicit price deflators for personal consumption expeditures.

[b] Current dollars from 1981 through 1983 inclusive and revenues divided by sales volume as reported on SE-1 forms by company. Averages are weighted by percent proportion of 1982 Net Energy for Load.

[c] 1983 estimate includes only January through October.

FIGURE D-3.1: NATURAL GAS CONSUMPTION BY SECTOR, 1982, OHIO AND U.S.



SOURCES: U.S. DEPARTMENT OF ENERGY, MONTHLY ENERGY REVIEW, APRIL 1983, AND THE OHIO DIVISION OF ENERGY.

TABLE D-3.1. SOURCE OF GAS SUPPLY FOR OHIO NATURAL GAS UTILITIES, 1981-1982 (ANNUAL PURCHASES IN MMCF)

	Interstate			Ohio Production			Green Springs[1]			Other Storage		Total Supply		
	1982	1981	1982 % of Total Supply	1982	1981	1982 % of Total Supply	1982	1981	1982 % of Total Supply	1982	1981	1982	1981	1982 % Ohio Supply
Cincinnati Gas & Electric	74,575	83,252	91.9	571	642	0.7	5,752	6,051	7.1	287	92	81,185	90,043	9.9
Columbia Gas Of Ohio	262,238	303,852	91.4	2,137	1,678	0.7	22,160	23,238	7.7	406	-608	286,941	328,164	35.0
Dayton Power and Light	49,364	56,555	90.0	0	0	0	4,247	1,965	7.7	1,244	1	54,875	58,521	6.7
East Ohio Gas	253,879	274,031	70.7	47,209	49,428	13.2	0	0	0	57,884	60,702	358,972	384,194	43.8
National Gas	8,537	9.026	58.6	5,142	5,631	35.3	0	0	0	878	1,019	14,557	15,676	1.8
Ohio Gas	6,432	6,165	93.7	137	824	2.0	0	0	0	292	384	6,861	7,373	0.8
River Gas	2,578	3,075	63.8	1,465	1,460	36.2	0	0	0	0	0	4,043	4,534	0.5
West Ohio Gas	11,531	12,389	92.9	0	0	0	875	926	7.0	4	0	12,410	13,315	1.5
Total	669,154	748,345		56,661	59,663		33,034	31,186		60,995	63,028	819,844	901,821	
% of Total	81.6%	82.8%		6.9%	6.6%		4.0%	0.6%		7.4%	6.7%	100.0%	100.0%	
% Change from 1981	-10.6%			-5.2%			5.9%			-3.2%		-9.1%		

SOURCES: Monthly reports of eight major Ohio gas utilities to the Ohio Division of Energy.

[1] A plant producing synthetic natural gas (SNG) from naphthas located in Green Springs, Ohio.

Totals may not add to 100 due to independent rounding.

TABLE D-3.2. NATURAL GAS CONSUMPTION BY SECTOR FOR OHIO UTILITIES, 1982 (MMCF)

Utility Company	- Residential-		- Commercial -		- Industrial -		- Other -		Total
	1982 Consumption	% of Resid. Consumption	1982 Consumption	% of Comm. Consumption	1982 Consumption	% of Indust. Consumption	1982 Consumption	% of Other Consumption	
Cincinnati Gas	34,490	9.7	20,560	13.2	26,159	11.3	-24	0	81,185
Columbia Gas	128,709	36.1	57,418	37.1	97,051	42.0	3,763	31.9	286,941
Dayton Power & Light	29,903	8.4	12,159	7.8	12,176	5.3	637	5.4	54,875
East Ohio Gas	150,944	42.3	58,571	37.8	81,958	35.5	3,575	30.3	295,048[a]
National Gas & Oil	1,652	0.5	800	0.5	7,417	3.2	3,111	26.3	12,980[a]
Ohio Gas	2,847	0.8	1,260	0.8	2,599	1.1	96	0.8	6,801[a]
River Gas	1,853	0.5	745	0.5	1,185	0.5	260	2.2	4,043
West Ohio Gas	6,025	1.7	3,399	2.2	2,591	1.1	395	3.3	12,410
Total	356,423	100	154,912	100	231,136	100	11,813	100	754,283

SOURCE: ODOE Form SG-1, Monthly Reports of Eight Major Ohio Gas Utilities.

[a] Storage (In) was deleted.

Percentage may not add up to 100 due to rounding.

TABLE D-3.3: NATURAL GAS PRICES IN OHIO, 1970-1982 (DOLLARS PER MCF)

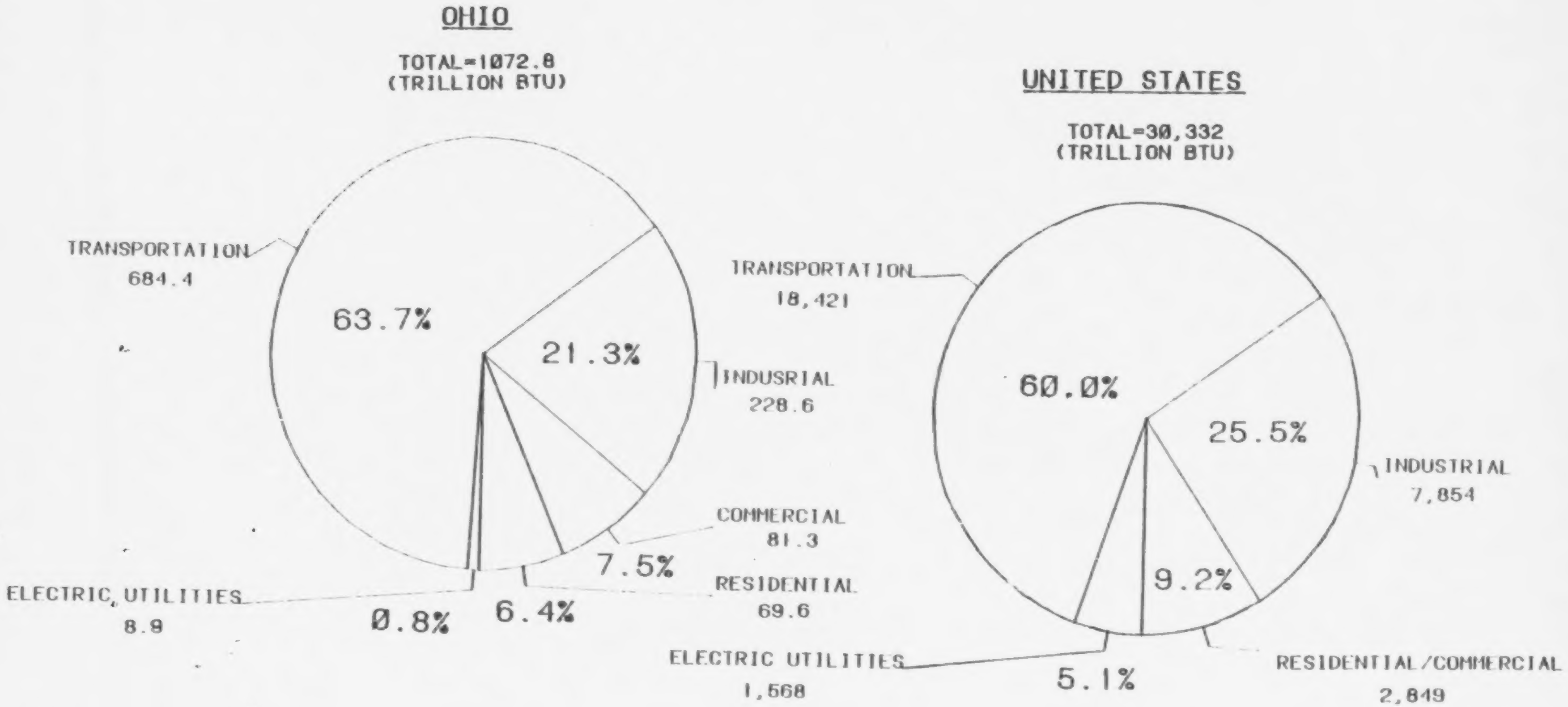
	Current Dollars[a]			Constant Dollars[b]		
	Residential	Commercial	Industrial	Residential	Commercial	Industrial
1970	0.86	0.75	0.54	0.93	0.81	0.58
1971	0.99	0.84	0.58	1.02	0.87	0.60
1972	1.05	0.89	0.64	1.05	0.89	0.54
1973	1.11	0.97	0.67	1.05	0.92	0.64
1974	1.27	1.10	0.88	1.09	0.94	0.75
1975	1.56	1.39	1.15	1.24	1.10	0.91
1976	1.85	1.68	1.47	1.39	1.26	1.10
1977	2.30	2.13	2.01	1.63	1.51	1.43
1978	2.51	2.31	2.11	1.67	1.54	1.41
1979	2.87	2.65	2.39	1.76	1.63	1.47
1980	3.56	3.33	3.06	1.99	1.86	1.71
1981	3.99	3.73	3.45	2.05	1.92	1.77
1982	4.65	4.39	4.07	2.26	2.13	1.98

SOURCES: The American Gas Association, Gas Facts. U.S. Department of Commerce, Statistical Abstract of the United States, 1982-83. U.S. Department of Commerce, Survey of Current Business.

[a] Current dollar prices represent annual average prices paid by Ohio consumers.

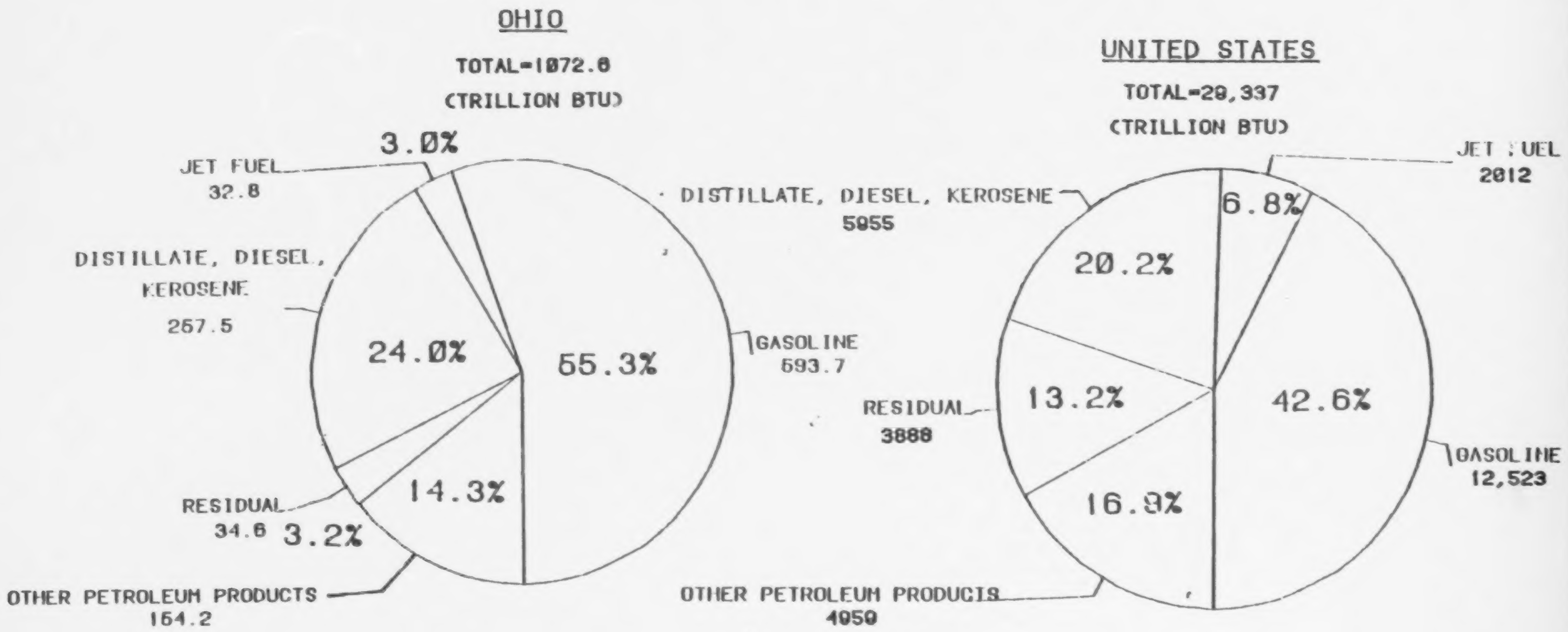
[b] The constant dollar figures (1972 = 100) reflect the real price increase of natural gas, excluding the effects of the general inflation rate. They show the actual impact of natural gas price increases on consumers, given a constant rather than declining purchasing power of the dollar compared to purchasing power for all other personal expenditure items. Values have been deflated using Implicit Price Deflators for "personal consumption expenditures."

FIGURE D-4.1: PETROLEUM CONSUMPTION BY SECTOR, 1982, OHIO AND U.S.



SOURCES: U.S. DEPARTMENT OF ENERGY, MONTHLY ENERGY REVIEW, APRIL 1983, AND THE OHIO DIVISION OF ENERGY.

FIGURE D-4.2. PETROLEUM CONSUMPTION BY PRODUCT, 1982, OHIO AND U.S.



SOURCES: U.S. DEPARTMENT OF ENERGY, PETROLEUM SUPPLY ANNUAL, JUNE 1983, AND THE OHIO DIVISION OF ENERGY.

TABLE D-4.1. GASOLINE PRICES FOR SELECTED CITIES IN OHIO AND U.S. URBAN AVERAGE, 1973-1983 (CURRENT CENTS PER GALLON)

	Leaded Regular			Unleaded Regular		
	Cincinnati	Cleveland	U.S. Urban Average	Cincinnati	Cleveland	U.S. Urban Average
1973	45[a]	42	42	N/A	N/A	N/A
1974	54	53	49	N/A	N/A	N/A
1975	58	59	57	N/A	N/A	N/A
1976	59	59	59	61	61	61
1977	61	61	62	65	64	66
1978	65	65	63	69	69	68
1979	86	88	88	90	91	92
1980	117	118	120	123	123	126
1981	127	130	131	135	139	138
1982	115	123	122	123	128	118
1983[b]	116	117	114	124	123	124

SOURCE: U.S. Bureau of Labor Statistics, Consumer Prices: Energy and Food, and the Ohio Divison of Energy.

[a] Estimated, Ohio Division of Energy.

[b] Price Average of the first six months of 1983.

TABLE D-4.2. OHIO NO.2 FUEL OIL AVERAGE ANNUAL PRICES BY SECTOR, 1976 - 1982 (CURRENT CENTS PER GALLON)

Year	Residential	Commercial/ Institutional	Industrial
1976	39[b]	32[b]	33[b]
1977	45	37	38
1978	47	38	39
1979	70	59	61
1980	96	96	84
1981	116	103	108
1982	113	104	93
1983	109[c]	95[c]	87[c]

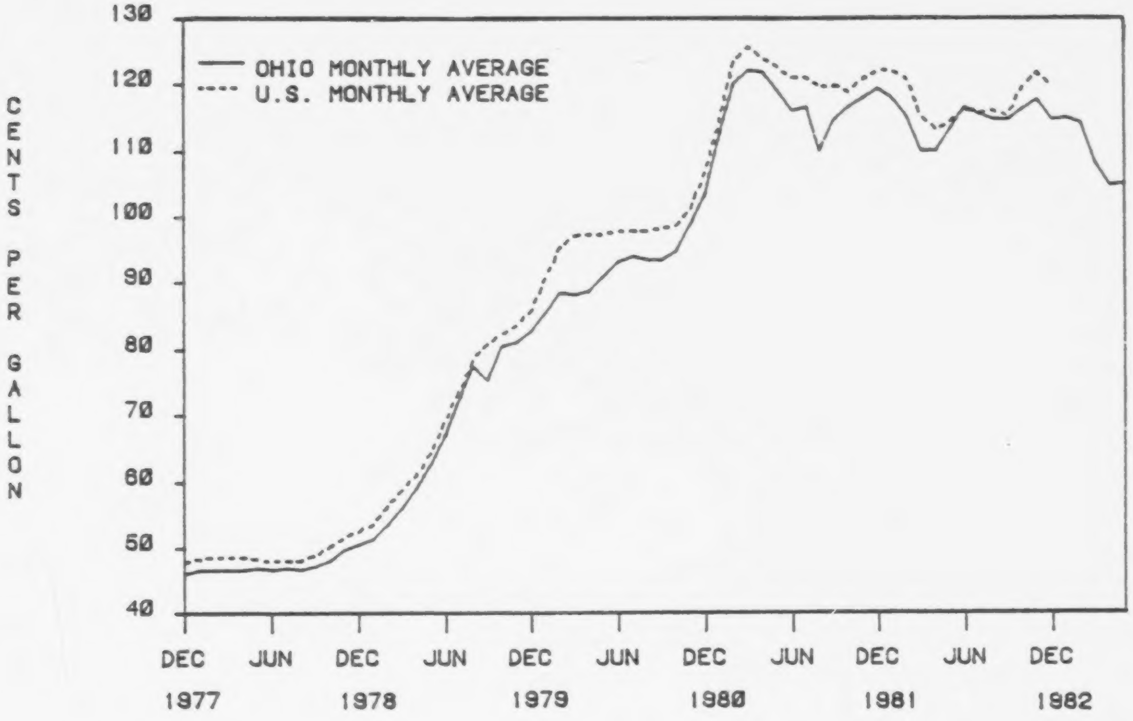
SOURCES: U.S. DOE, *Monthly Energy Review*.
U.S. DOE, *Monthly Petroleum Product Price Report*.
U.S. DOE, *Petroleum Marketing Monthly*.

[a] Figures are representative of U.S. DOE Region 5, the East North Central Geographical region. Taxes are included.

[b] June through December average.

[c] January through April average.

FIGURE D-4.3. OHIO AVERAGE RESIDENTIAL SECTOR PRICES OF NO.2 FUEL OIL, DECEMBER 1977 - MAY 1983 (CURRENT CENTS PER GALLON)



SOURCES: U.S. Department of Energy, Energy Information Administration, "Prices and Margins of No. 2 Distillate Fuel Oil," EIA-0013, The Ohio Division of Energy, Monthly Heating Oil Price Monitoring Survey. U.S. data, consistent with previous data, available through December 1982 only.

TABLE D-4.3: OIL AND GAS WELL COMPLETIONS IN OHIO, 1970-1982

	Gas Wells		Oil Wells		Combination Wells		Dry Holes		
Year	No.	Percent	No.	Percent	No.	Percent	No.	Percent	Total Wells
1970	517	38.15	325	23.99	323	23.83	190	14.02	1,355
1971	542	43.78	244	19.70	279	22.53	173	13.97	1,238
1972	588	45.47	178	13.77	359	27.76	168	12.99	1,293
1973	759	50.53	145	9.65	432	28.76	166	11.05	1,502
1974	768	43.49	247	13.99	584	33.07	167	9.46	1,766
1975	417	34.18	208	17.05	480	39.34	115	9.43	1,220
1976	816	42.14	213	11.00	743	38.37	164	8.47	1,936
1977	844	32.16	372	14.18	1,237	47.14	171	6.52	2,624
1978	844	32.39	273	10.47	1,273	48.85	216	8.29	2,606
1979	1,097	31.86	251	7.29	1,927	55.97	168	4.88	3,443
1980	818	24.37	276	8.22	2,154	64.18	108	3.22	3,356
1981	1,256	23.15	394	7.26	3,419	63.02	356	6.56	5,425
1982	1,095	23.59	317	6.83	2,901	62.49	329	7.09	4,642

SOURCES: Ohio Department of Natural Resources, Division of Oil and Gas, Summary of Ohio Oil and Gas Developments in 1982.

[a] Does not include wells reopened, gas storage wells, secondary recovery, service wells or lost holes.

GLOSSARY OF SELECTED TERMS

ASPHALT[f] - A petroleum product, extracted as a refining residue or by solvent precipitation from residual fractions. Solid or semi-solid at normal temperatures, asphalt liquefies when heated. It is a powerful binding agent, a sticky adhesive and a highly waterproof, durable material in which the predominating constituents are bitumens.

BTU - (British Thermal Unit)[b] The standard unit for measuring quantity of heat energy, such as the heat content of fuel. It is the amount of heat energy necessary to raise the temperature of one pound of water one degree Fahrenheit. Based on its Btu content, any kind and quantity of fuel burned may be expressed as an equivalent quantity of some other kind of fuel. TBtu = 1.0×10^{12} Btu.

CHAR[a] - A porous, solid residue resulting from the incomplete combustion of organic material. If produced from coal, it is called coke; if produced from wood or bone, it is called charcoal. It is more nearly pure carbon than the coal, wood, or bone from which it is produced.

CLASS A AUDIT[c,a] - An on-site visit at a building by an energy specialist consisting of an evaluation of the building's energy consumption and energy systems. The evaluation includes an analysis of the energy and cost savings likely to result from the purchase and installation of one or more modifications. An audit also includes general recommendations and provides a workbook, manual, or other instructional materials enabling purchase and installation of one or more modifications.

COAL GASIFICATION[d] - The conversion of coal, coke, or char to gaseous products by reaction with air, hydrogen, oxygen, steam, carbon dioxide, or a mixture of these. Products consist of carbon dioxide, carbon monoxide, hydrogen, methane, and other chemicals, usually of low to intermediate-Btu quality for industrial uses.

COAL LIQUEFACTION[d] - The conversion of most types of coal, anthracite excepted, by direct or indirect technologoies (usually by hydrogenation, the addition of hydrogen) primarily to produce synthetic low-sulfur, low-ash liquid or solid fuels to replace some of the fuel coal used by electric utilities.

COGENERATION[d] - The simultaneous generation of electric energy and useful low-grade heat from the same source. Two main approaches are possible: moving electrical generation to the user's facility, and moving the waste heat to the user.

DISTILLATE FUEL[d] - A broad term for any one of the wide variety of fuels obtained from fractions boiling above gasoline in the distillation of petroleum. The most important distillate fuels are kerosene, furnace oils, and diesel fuels. (See also FUEL OIL.)

DRY HOLE WELL[a] - A drilled well which does not yield gas and/or oil in quantities or condition to support commercial production.

ENERGY FOR NET GENERATION[a] - Calculated as the difference between: a) total consumption of energy by the electric utilities sector (fuels used for generation) and b) the Btu equivalent of the electricity generated (sales of electricity to all sectors).

FUEL OIL[d] - Any of the petroleum products which are less volatile than gasoline and are burned in furnaces, boilers, or other types of heaters. The two primary classes of fuel oils are distillate and residual. Distillate fuel oils are composed entirely of material which has been vaporized in a refinery distillation tower. Consequently, they are clean, free of sediment, relatively low in viscosity, and free of inorganic ash. Residual fuel oils contain fractions which cannot be vaporized by heating. These fractions are black and viscous and include any inorganic ash components which are in the crude. In some cases, whole crude is used as residual fuel.

JET FUEL[a] - Any of several compounds designated commercial jet fuels or military jet fuels including kerosene types and combinations with naphtha. They are derived mostly from the range of middle distillates.

KEROSENE[a] - A mixture of hydrocarbons obtained by the fractional distillation of petroleum and used as a fuel for jet engines and gas turbines. It consists of slightly heavier hydrocarbons than are found in gasoline and naphtha.

LIQUIFIED PETROLEUM GAS (LPG)[a,d]
- Commonly known as "bottled gas." A gas containing certain specific hydrocarbons which are gaseous under normal atmospheric conditions, but can be liquefied under moderate pressure at normal temperatures. Propane and butane are the principal examples. Often employed as fuel (particularly clean-burning), for tractors, trucks, and buses, and mainly as a domestic fuel in remote areas.

OPEC[a] - The Organization of Petroleum Exporting Countries is an organization whose members include countries from the Middle East, North Africa, and South America, which aims at developing common oil-marketing policies.

PETROLEUM COKE[d] - A petroleum by-product resulting from the conversion of heavy residual bottoms of crude oil to lower-boiling petroleum products. Petroleum coke is used principally as fuel or, after calcining, for carbon electrodes. The sulphur content of petroleum coke is governed by the grade of crude oil from which it is produced, and all petroleum cokes are characterized by low total ash contents.

PETROCHEMICAL FEEDSTOCK[a] - Hydrocarbons which are to be charged to any process equipment or used as a raw material for a product.

PROCESS ENERGY[e] - Energy used in the direct production of a commodity or service, excluding such indirect energy inputs as energy used to process or transport raw materials and to construct factories and equipment. In an energy audit, the process energy requirement is useful in comparing the energy implications of alternative processes to determine where energy conservation methods can best be applied.

PROVEN RESERVE[a] - An estimation of real fuel resource based on an adequate control of subsurface information to verify that resource, based on existing technology and current economic and social conditions.

PUMPED STORAGE ELECTRIC GENERATING CAPACITY[b] - An arrangement whereby additional electric power may be generated during peak load periods by hydraulic means using water pumped into a storage reservoir during off peak periods.

RESIDUAL FUEL OIL[a] - The heavy residue of petroleum that remains after lower boiling fractions are distilled. It is used primarily for generating electricity in industry and large commercial buildings. (See also FUEL OIL.)

SELF-HELP GAS[a] - Natural gas that is produced from industry-owned wells and delivered from the wellhead to an industrial plant via private pipeline. Industries' payment of transmission charges is one condition of this statewide program.

SOURCES:

[a] The Ohio Department of Development, Division of Energy.

[b] Edison Electric Institute. Glossary of Electric Utility Terms. New York: Statistical Committee of the Edison Electric Institute, 1977.

[c] Code of Federal Regulations, (CFR) Chapter II, Section 450.11.

[d] Parker, Sybil P., ed. McGraw Hill Encyclopedia of Energy. New York: McGraw-Hill Book Company, 1981.

[e] Crabbe, David, and McBride, Richard. The World Energy Book. New York: Nichols Publishing Company, 1978.

[f] Government Institutes. Energy Reference Handbook. (2nd Ed.) 1977.